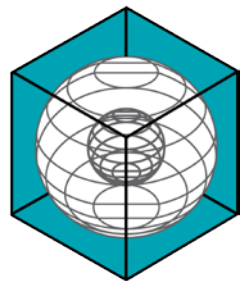


***A METHODOLOGY FOR CALCULATING  
INTEGRATED NO<sub>x</sub> EMISSIONS REDUCTIONS  
FROM ENERGY EFFICIENCY AND  
RENEWABLE ENERGY (EE/RE) PROGRAMS  
ACROSS STATE AGENCIES IN TEXAS***

**Jeff S. Haberl, Ph.D., P.E.**

**Energy Systems Laboratory  
Texas Engineering Experiment Station  
Texas A&M University System**



# Acknowledgements

Faculty & Staff: Bahman Yazdani, Charles Culp, Larry Degelman, Rose Sauser, Juan-Carlos Baltazar, Jaya Mukhopadhyay, Hyojin Kim, Patrick Parker, Stephen O'Neal, and David Claridge.

Students: Sung Lok Do, Kee Han Kim, Chunliu Mao, and Georgina Davis

State & Federal Agencies: Theresa Gross and Rebecca Reed (PUC), Stephen Ross and Dub Taylor (SECO), Vincent Meiller (TCEQ), Warren Lasher and Dan Woodfin (ERCOT), James Yarbrough and Art Diem (USEPA).





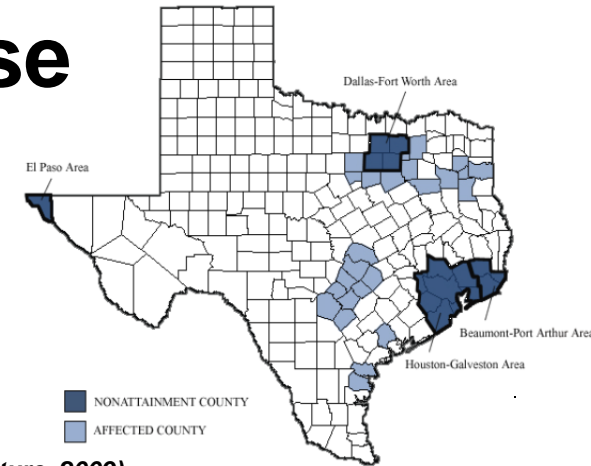
# Legislative Response

41 Counties in Texas designated non-attainment or affected  
Legislation passed to reduce energy/emissions



# Legislative Response

41 Counties in Texas designated non-attainment or affected  
Legislation passed to reduce energy/emissions



## **Senate Bill 5 (77<sup>th</sup> Legislature, 2001)**

### **Ch. 386. Texas Emissions Reduction Plan**

Sec. 386.205. Evaluation Of State Energy Efficiency Programs (with PUC)

### **Ch. 388. Texas Building Energy Performance Standards**

Sec. 388.003. Adoption Of Building Energy Efficiency Performance Standards. Sec. 388.004. Enforcement Of Energy Standards Outside Of Municipality. Sec. 388.007. Distribution Of Information And Technical Assistance. Sec. 388.008. Development Of Home Energy Ratings.

## **TERP Amended (78<sup>th</sup> Legislature, 2003)**

### **Ch. 388. Texas Building Energy Performance Standards**

(HB 1365) Sec. 388.004. Enforcement of Energy Standards outside of Municipality.

(HB 1365) Sec. 388.009. Energy-Efficient Building Program.

### **Ch. 388. Texas Building Energy Performance Standards**

(HB 3235) Sec. 388.009. Certification of Municipal Inspectors.

## **TERP Amended (79<sup>th</sup> Legislature, 2005)**

### **Ch. 382. Health and Safety Code**

(HB 2129) Sec. 386.056 Development of Creditable Statewide emissions from wind and other renewables.

(HB 965) Sec. 382.0275 Commission Action Relating to Water Heaters

## **TERP Amended (80<sup>th</sup> Legislature, 2007)**

### **Ch. 382. Health and Safety Code**

(HB 3693) Sec. 388.003 added subsection (b-1), (b-2), (b-3) that allows SECO to adopt new editions of the IECC based on written recommendations from the Laboratory.

(HB 3693) Sec. 388.008 Development of Standardized report formats for newly constructed residences.

### **Ch. 386. Health and Safety Code**

(SB 12) Section 388.03 added subsection (b-1), (b-2) allows SECO to adopt new editions of the IECC based on written recommendations from the Laboratory.

## **TERP Amended (81<sup>st</sup> Legislature, 2009)**

### **Ch. 382. Health and Safety Code**

(HB 1796) Section 23 amends Sec. 386.252 (a) and (b) extends date of TERP to 2019 and requires Commission to contract with Laboratory for creditable EE/RE emissions reductions.

## **TERP Amended (82<sup>nd</sup> Legislature, 2011)**

### **Ch. 477. Government Code**

(HB 51) Sec 477.004 added subsection (b-2), directing SECO to appoint a new advisory committee for selecting high-performance building design evaluation systems . The committee includes a representative from the Laboratory and meets at least once every two years.

### **Ch. 388. Health and Safety Code**

(HB 51) Sec 388.003 (e) and & Sec 388.007 (c) amend review of municipal's amendments.

(HB 51) Sec 388.007 (d) allows the Laboratory to conduct outreach to the real estate industry on the value of energy code compliance and above code construction.

(SB 898) Sec 388.006 requires the Laboratory to calculate energy savings and emissions reduction for political subdivisions based on info collected by SECO, and report findings to TCEQ , EPA, and ERCOT.

### **Chapter 39. Utilities Code**

(SB 924) Sec 39.9051 (g) (h) & Sec 39.9052 (c) (d) require the Laboratory to calculate energy savings and emissions reductions for municipally owned utilities and electric cooperatives reporting to SECO.



# **INTEGRATED NO<sub>x</sub> SAVINGS**

**IN 2005 TCEQ INITIATED A PROGRAM TO  
DETERMINE INTEGRATED EMISSIONS SAVINGS  
(from 2005 to 2020) TO REPORT SAVINGS TO EPA**

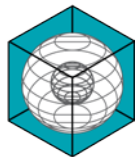


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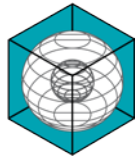


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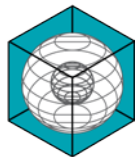


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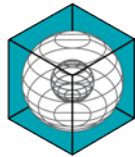


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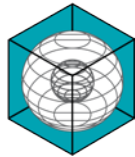


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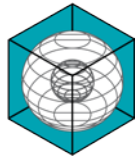


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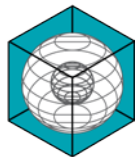
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- TCEQ
- EPA
- PUC
- SECO
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## **Savings Integration allows:**



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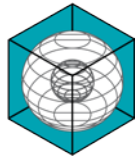
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## **Savings Integration allows:**

- Annual, OSD savings



# INTEGRATED NO<sub>x</sub> SAVINGS

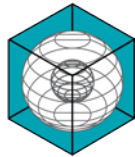
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- TCEQ
- EPA
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## **Savings Integration allows:**

- Annual, OSD savings
- By County, SIP, Program



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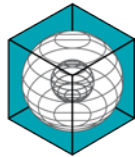
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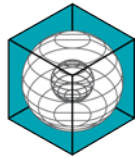
## **Savings Integration allows:**

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- By County, SIP, Program
- Integration tool =  
Adjustable Discount,  
Degradation, T&D losses



# INTEGRATED NO<sub>x</sub> SAVINGS:

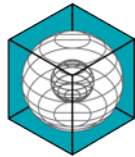
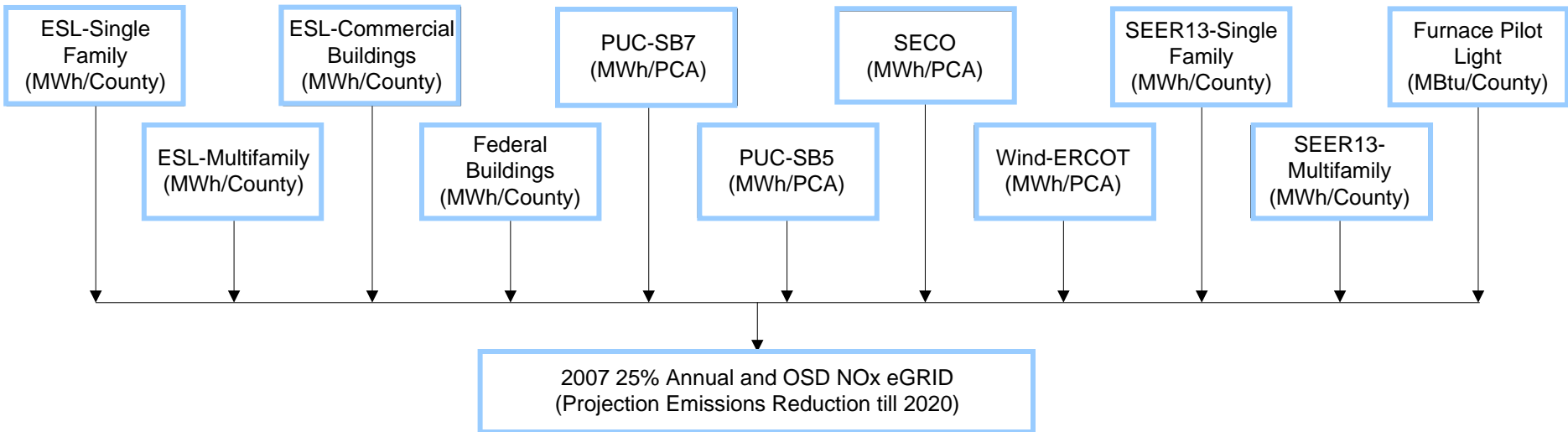
## Process Flow Diagram of the NO<sub>x</sub> Emissions Reduction Calculations





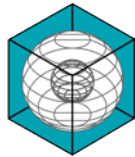
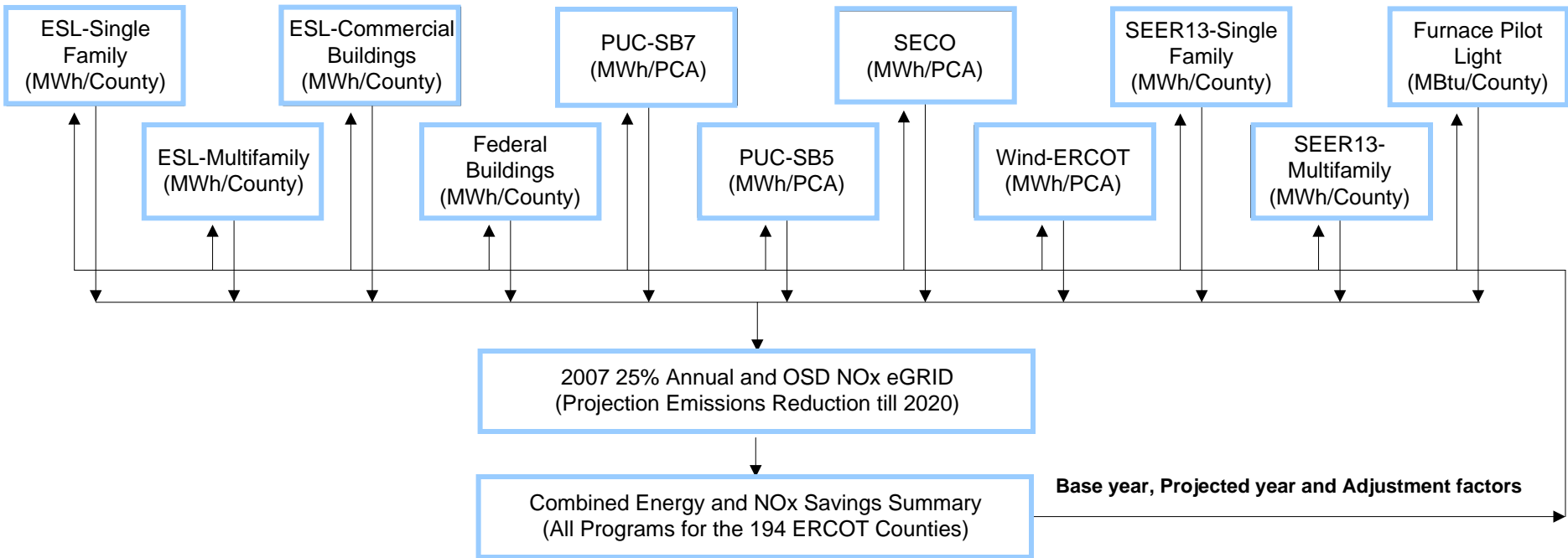
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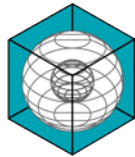
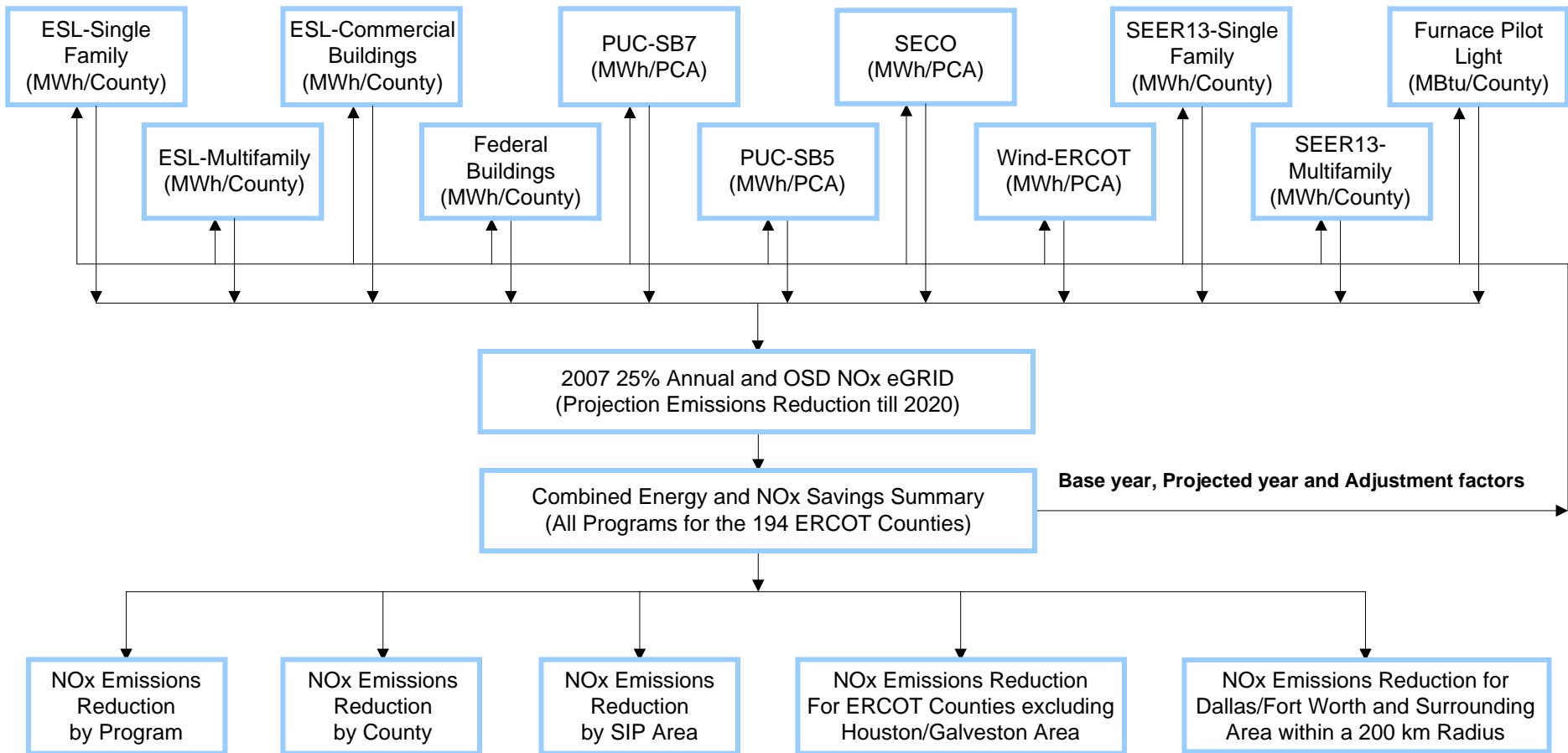
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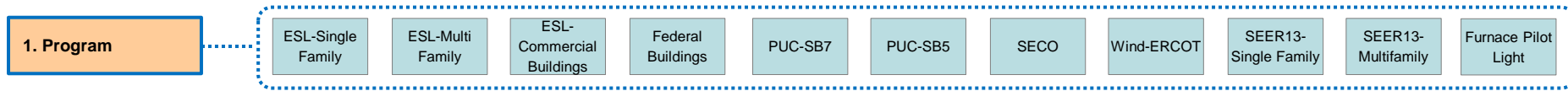
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## **Data File Flow Diagram of the NO<sub>x</sub> Emissions Reduction Calculations**



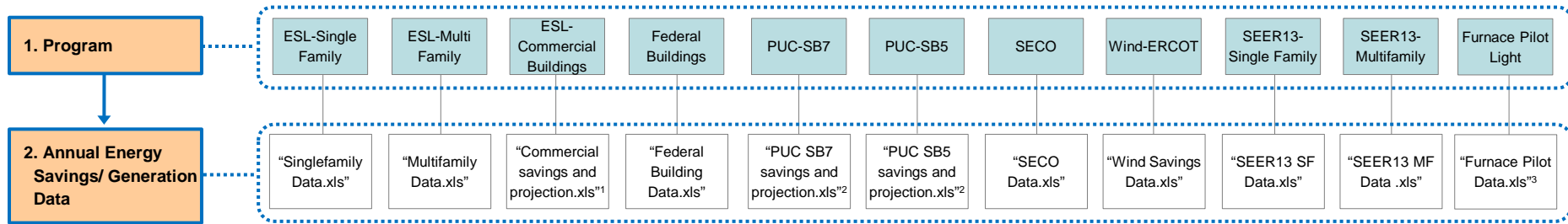
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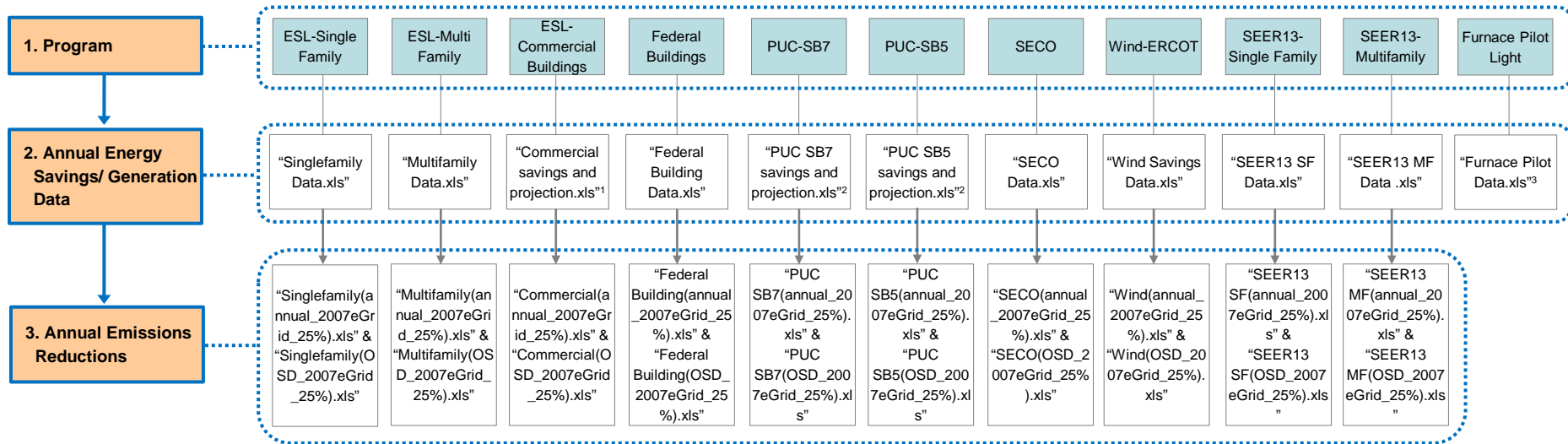
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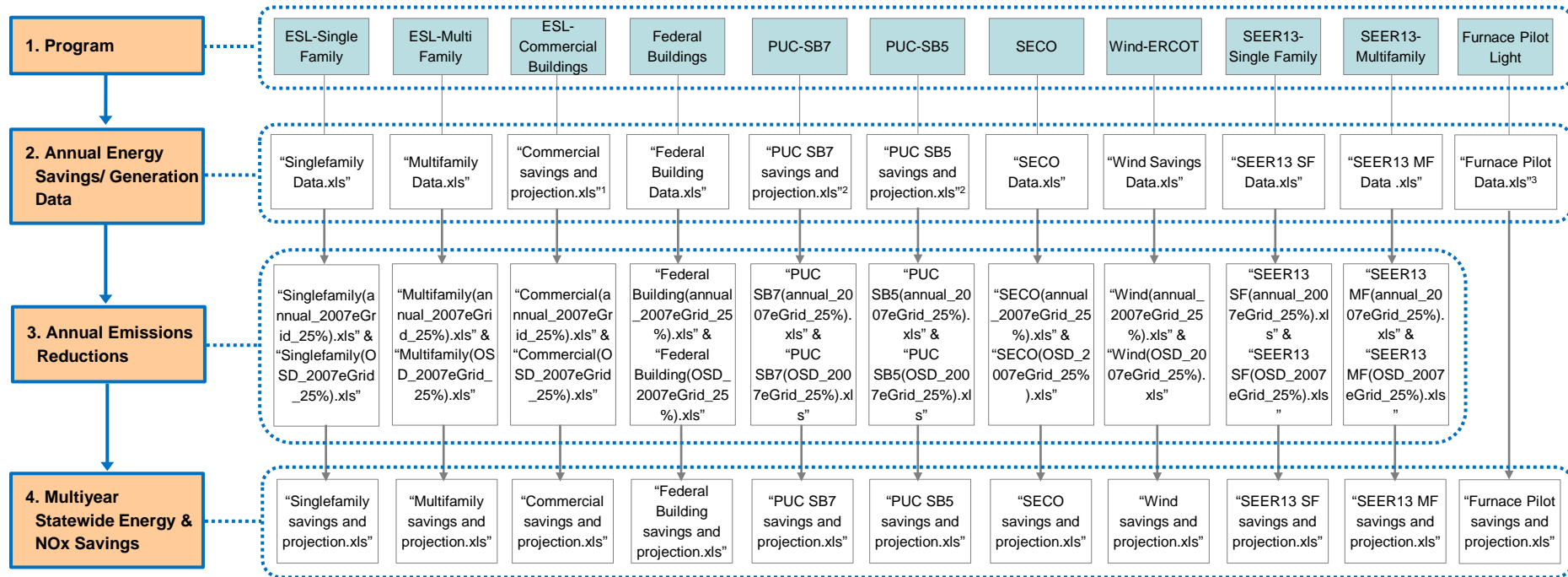
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## Data File Flow Diagram of the NOx Emissions Reduction Calculations



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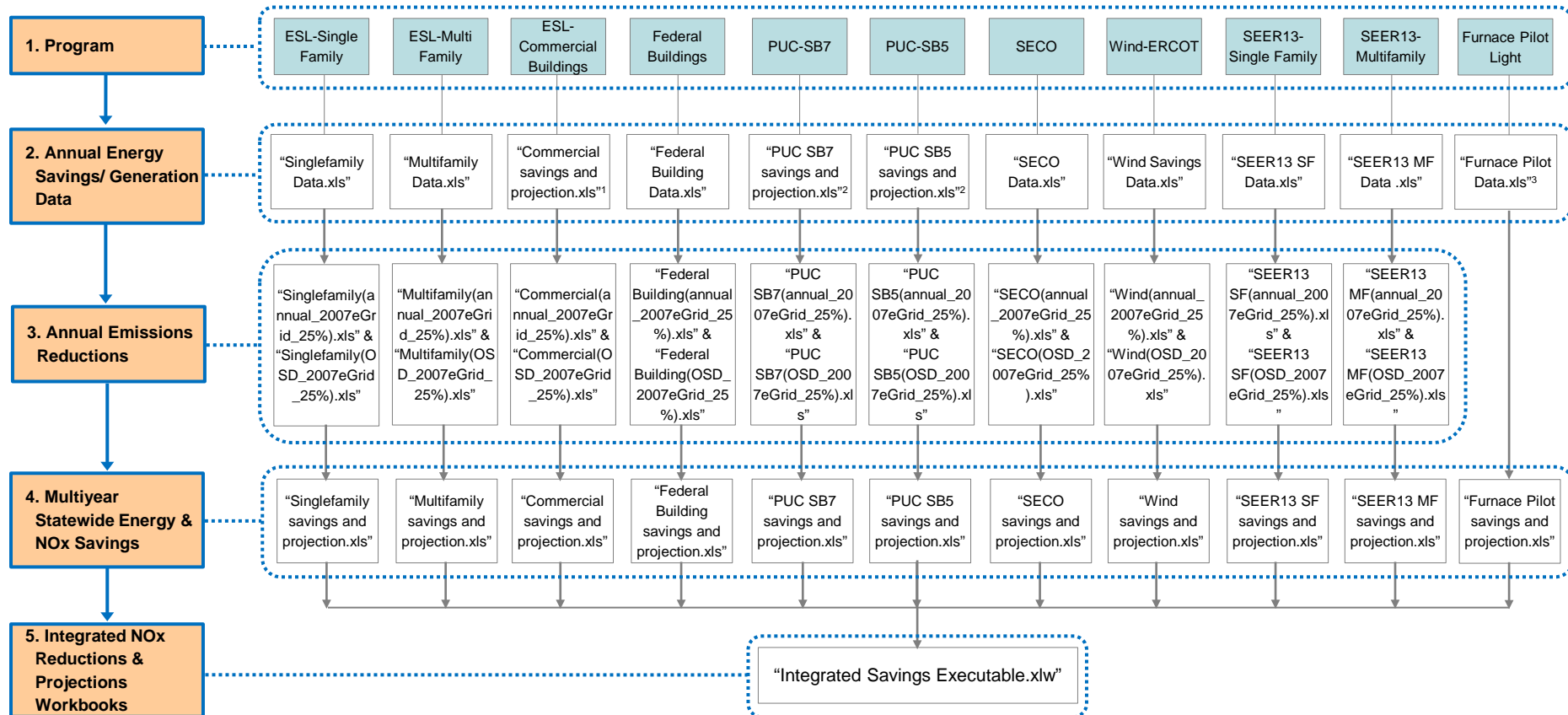
## Data File Flow Diagram of the NO<sub>x</sub> Emissions Reduction Calculations





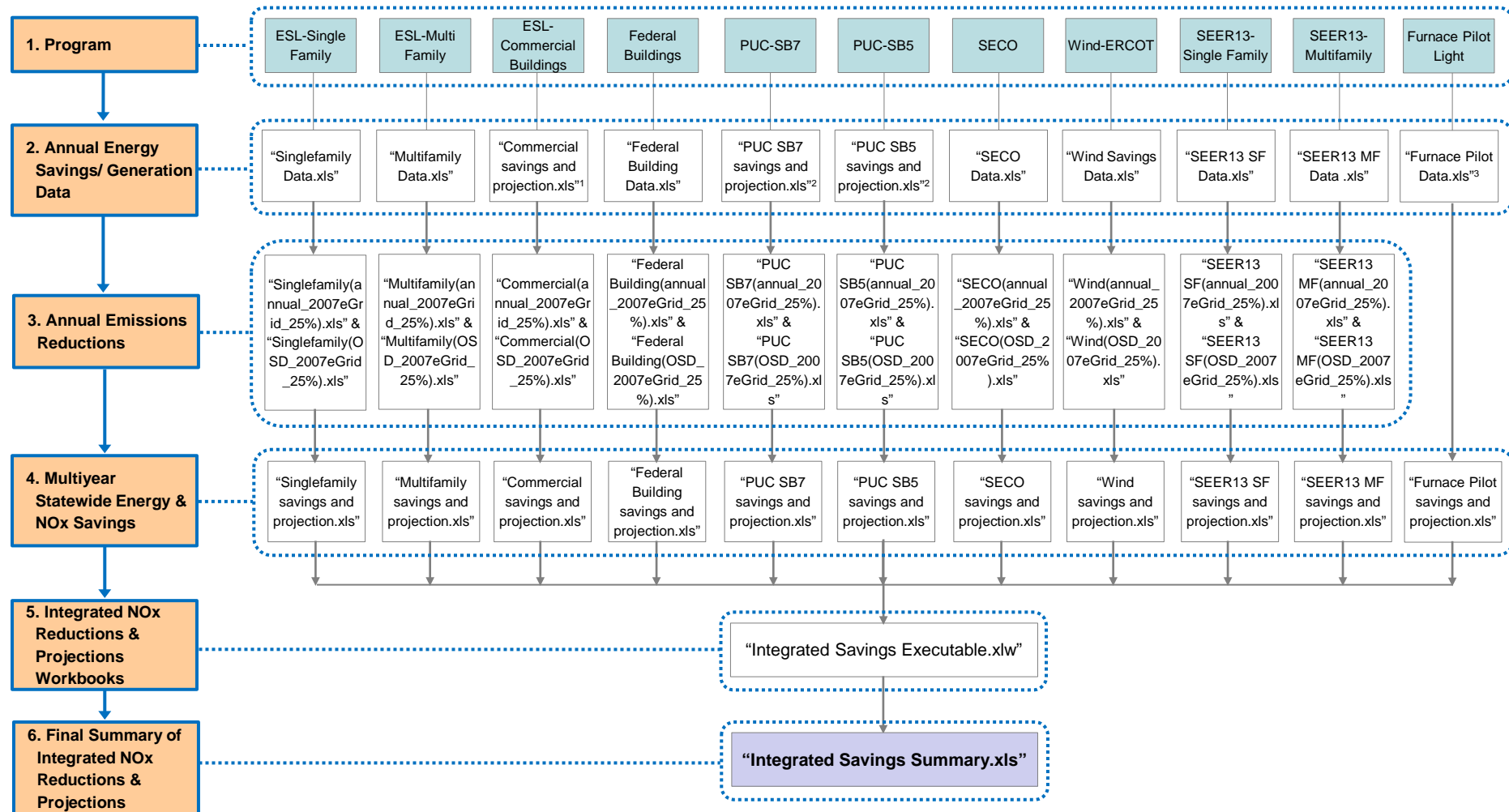
# INTEGRATED NOx SAVINGS:

## Data File Flow Diagram of the NOx Emissions Reduction Calculations



# INTEGRATED NO<sub>x</sub> SAVINGS:

## Data File Flow Diagram of the NO<sub>x</sub> Emissions Reduction Calculations



Note: 1. Energy savings data for commercial buildings are found in two excel files: Commercial Data.xls & Commercial savings and projection.xls.  
 2. Energy savings data for PUC SB5 and PUC SB7 are found in their savings and projection excel files.  
 3. The emissions factors contained in eGRID used for electricity savings only. Due to this, eGrid cannot be used for the emissions reduction in the furnace Pilot Light program achieved the N.G. savings by retrofitting existing furnaces.



# OSD 2007 eGrid for ERCOT EGUs

Area	(lbs)	American Electric Power (EPC)		NEX		Austin Electric (EPC)		NEX		Brownsville Public Utilities Board (EPC)		NEX		Lower Colorado River Authority (EPC)		NEX		Reliant Energy (EPC)		NEX		San Antonio Public Service (EPC)		NEX		South Texas Electric Co. (EPC)		NEX		Texas Municipal Electric (EPC)		NEX		Texas-New Mexico Power (EPC)		NEX		Total NEX																																																																																																																																																																																																																																																																																																													
		Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)	Reductions (lbs)																																																																																																																																																																																																																																																																																																															
Houston-Galveston Area	Brazoria	0.00957127	5.42264354	0.01106675	0.03191143	0.007069474	0.000428368	0.47528866	0.07100776	118.499441	0.016140391	9.3738066	0.006781035	0.005179719	0.012628049	4.76285892	0.008771659	33.56016258	172.748077	0.08374004	0.02181395	1.2935373	0.02703413	0.03124031	0.009625957	0.01513807	0.009062551	0.011950527	4.3693881	6.4169424	3.7488917	0.01444885	0.005659513	3.1560937	0.06887309	1.8342077	154.891334	954.220575	0.4711025																																																																																																																																																																																																																																																																																																												
	Chambers	0.02181395	12.995373	0.02703413	0.03612362	0.01601386	0.009125896	1.01730802	0.03777498	276.788817	0.01513807	9.373806	0.006781035	0.005179719	0.012628049	4.76285892	0.008771659	33.56016258	172.748077	0.08374004	0.02181395	1.2935373	0.02703413	0.03124031	0.009625957	0.01513807	0.009062551	0.011950527	4.3693881	6.4169424	3.7488917	0.01444885	0.005659513	3.1560937	0.06887309	1.8342077	154.891334	954.220575	0.4711025																																																																																																																																																																																																																																																																																																												
	Fort Bend	0.005659513	3.1560937	0.06887309	1.8342077	0.041133619	0.002288739	2.58939382	0.422127404	270.4155639	0.00901908	57.7172598	0.038531472	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038	0.022449038																																																																																																																																																																																																																																																																																																											
	Galveston	0.02755985	15.515586	0.03398644	0.091147567	0.020351324	0.012787501	1.429392152	0.24144635	336.2072396	0.008812515	27.7176538	0.031823685	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514	0.01677514																																																																																																																																																																																																																																																																																																										
	Harris	0.0773051	43.8379404	0.0966272	2.54768564	0.05713394	0.032264145	3.5964464	0.596331222	978.565871	0.133205	80.1688107	0.653519831	0.033598954	0.040461927	1.54427139	0.05623098	215.1428977	1326.40393	0.662701952	0.0773051	43.8379404	0.0966272	2.54768564	0.05713394	0.032264145	3.5964464	0.596331222	978.565871	0.133205	80.1688107	0.653519831	0.040461927	1.54427139	0.05623098	215.1428977	1326.40393	0.662701952	0.0773051	43.8379404	0.0966272	2.54768564	0.05713394	0.032264145	3.5964464	0.596331222	978.565871	0.133205	80.1688107	0.653519831	0.040461927	1.54427139	0.05623098	215.1428977	1326.40393	0.662701952																																																																																																																																																																																																																																																																																											
	Liberty	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000</

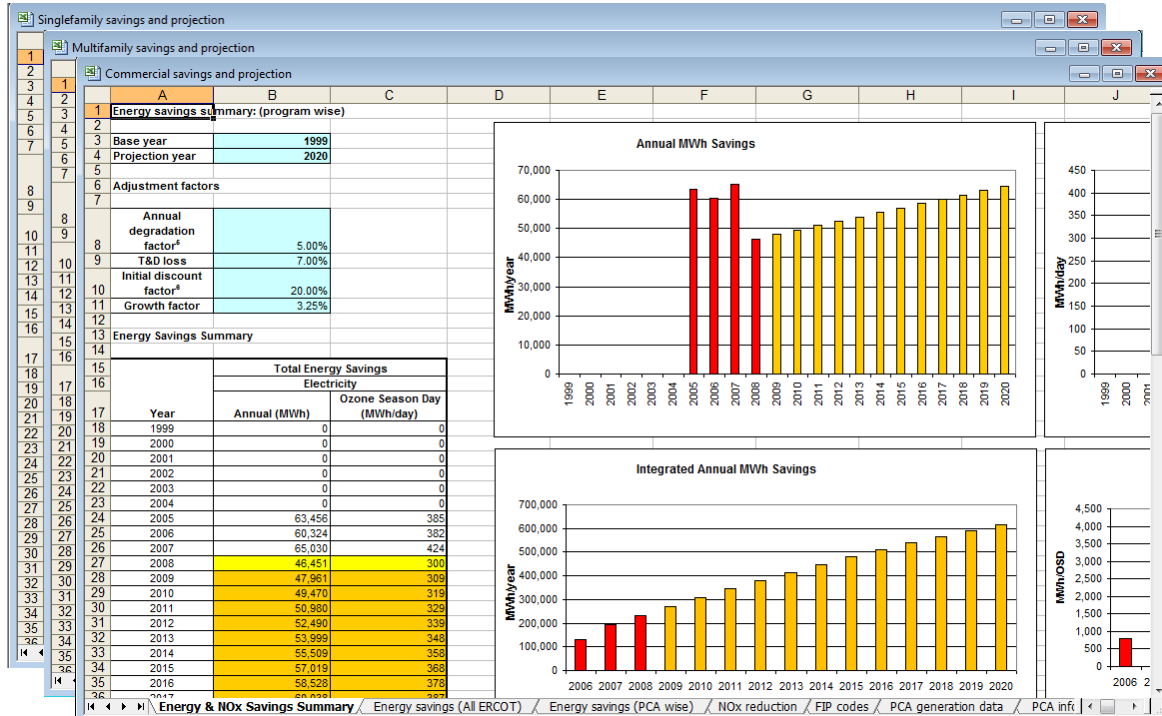
# **INTEGRATED NO<sub>x</sub> SAVINGS:**

## **Final Summary Tables For Integrated NO<sub>x</sub> Reductions & Projections**



# INTEGRATED NO<sub>x</sub> SAVINGS:

## Final Summary Tables For Integrated NO<sub>x</sub> Reductions & Projections

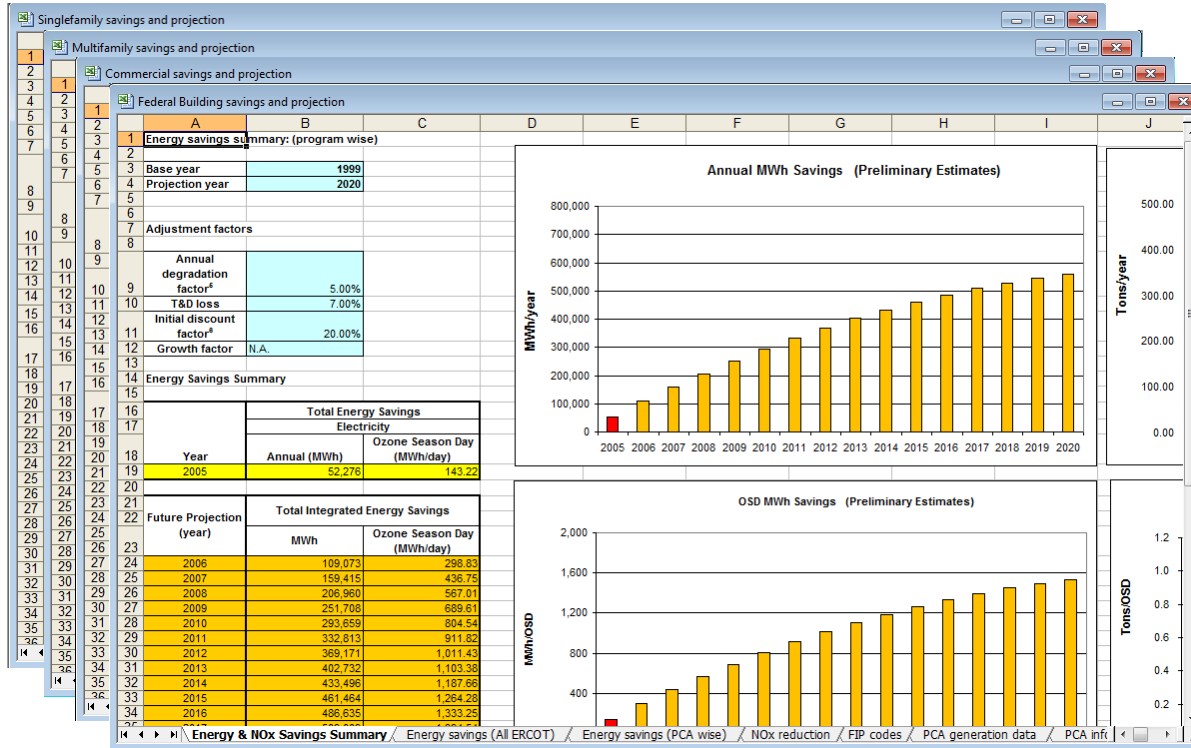


ESL-Single Family / ESL-Multi Family / ESL-Commercial Buildings



# INTEGRATED NOx SAVINGS:

## Final Summary Tables For Integrated NOx Reductions & Projections

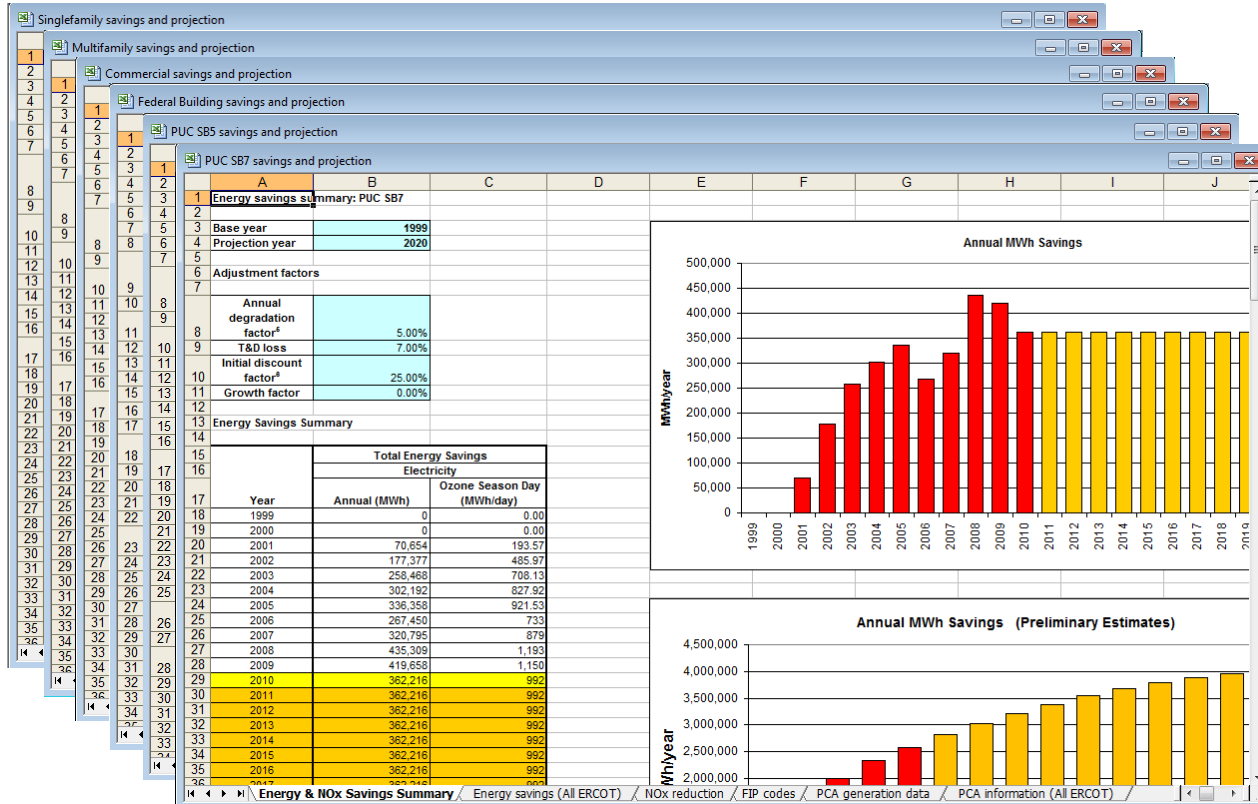


Federal Buildings



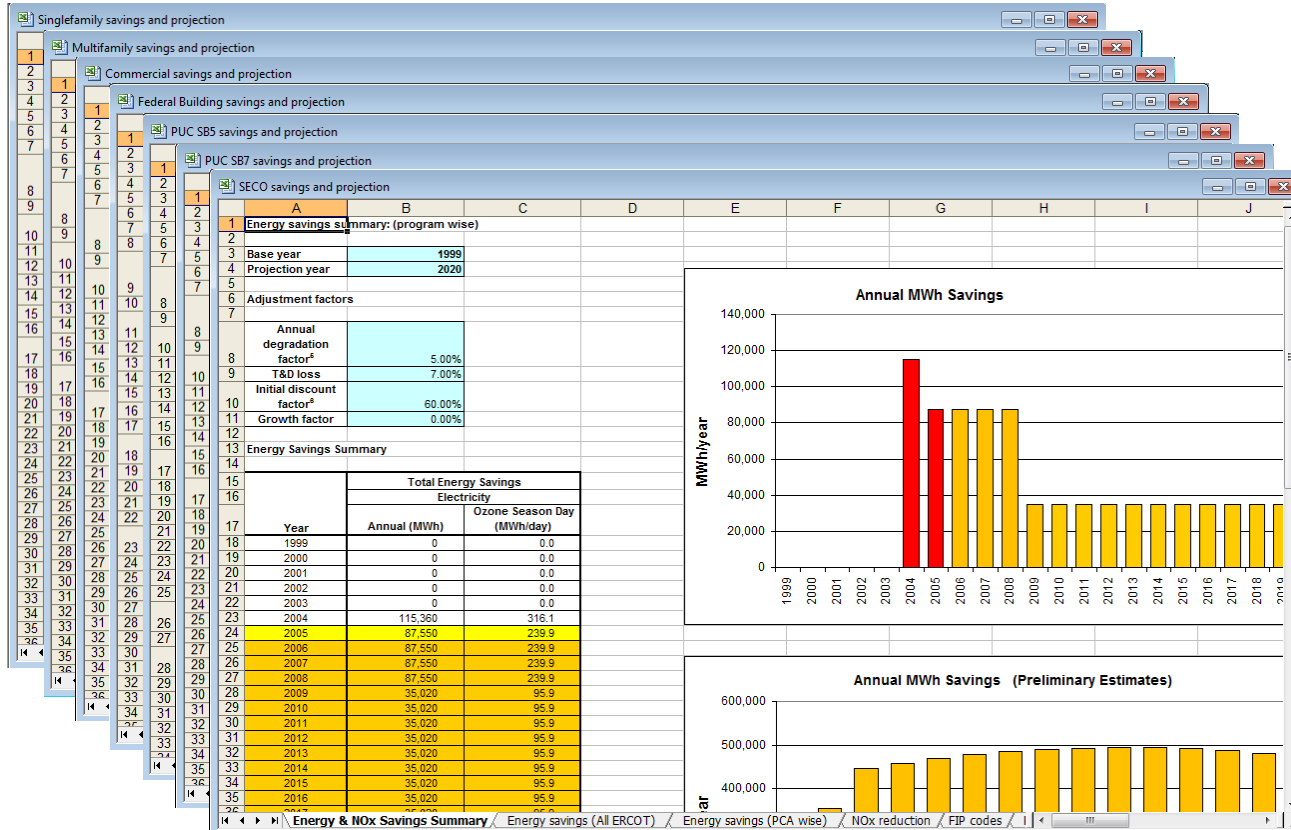
# INTEGRATED NO<sub>x</sub> SAVINGS:

## Final Summary Tables For Integrated NO<sub>x</sub> Reductions & Projections



# INTEGRATED NOx SAVINGS:

## Final Summary Tables For Integrated NOx Reductions & Projections



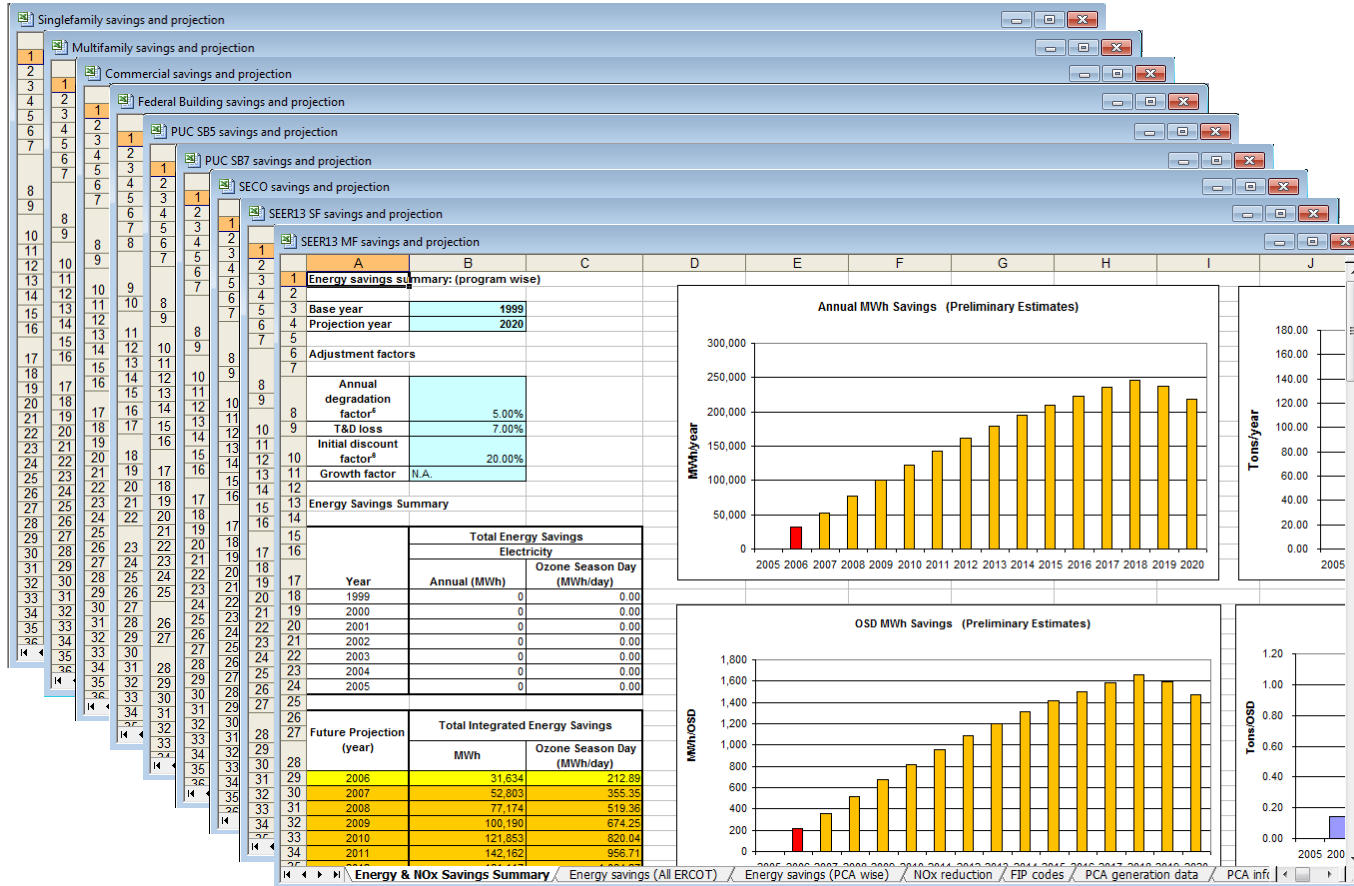
SECO





# INTEGRATED NOx SAVINGS:

## Final Summary Tables For Integrated NOx Reductions & Projections

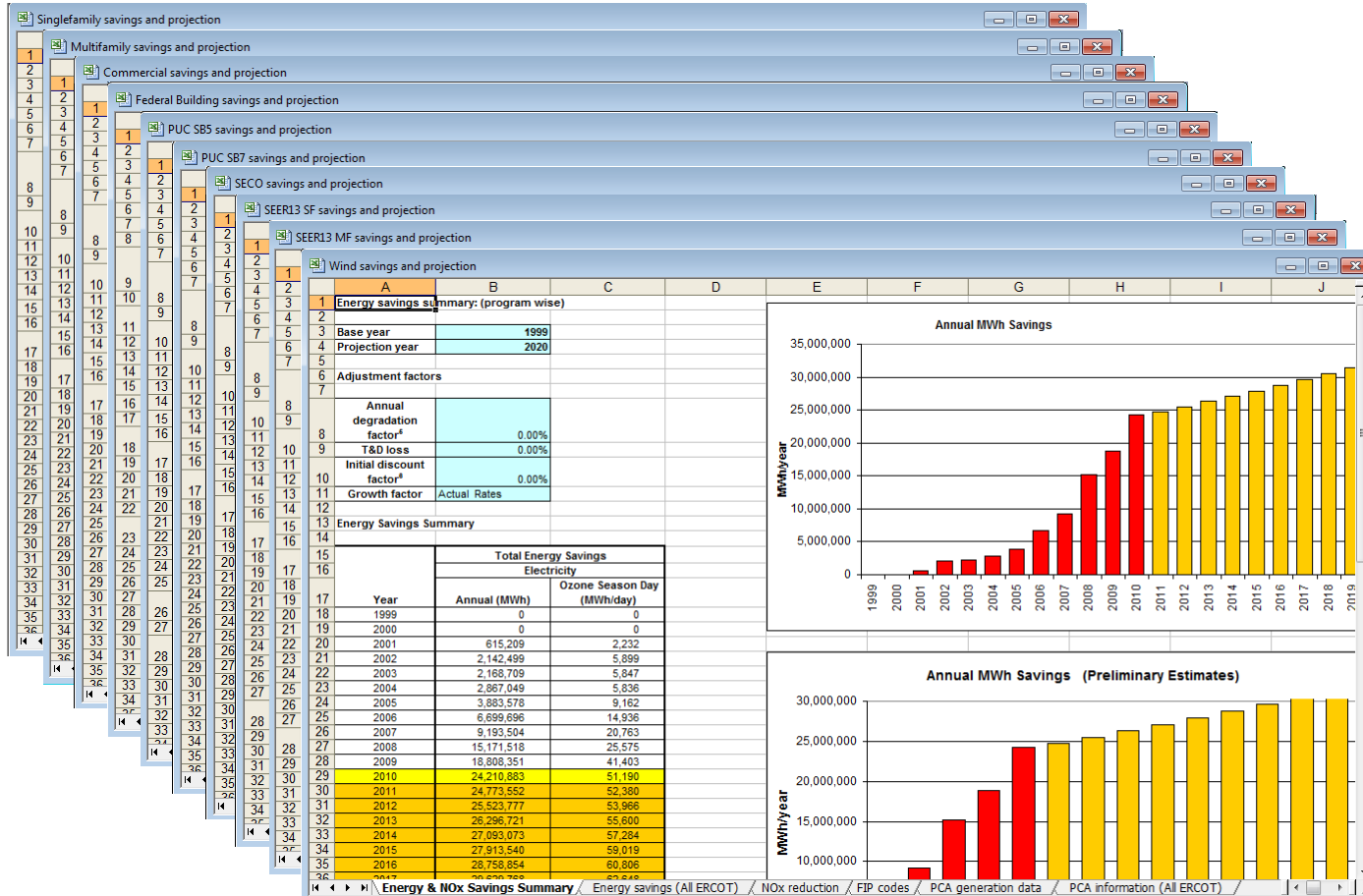


SEER13 MF / SEER13 SF



# INTEGRATED NOx SAVINGS:

## Final Summary Tables For Integrated NOx Reductions & Projections

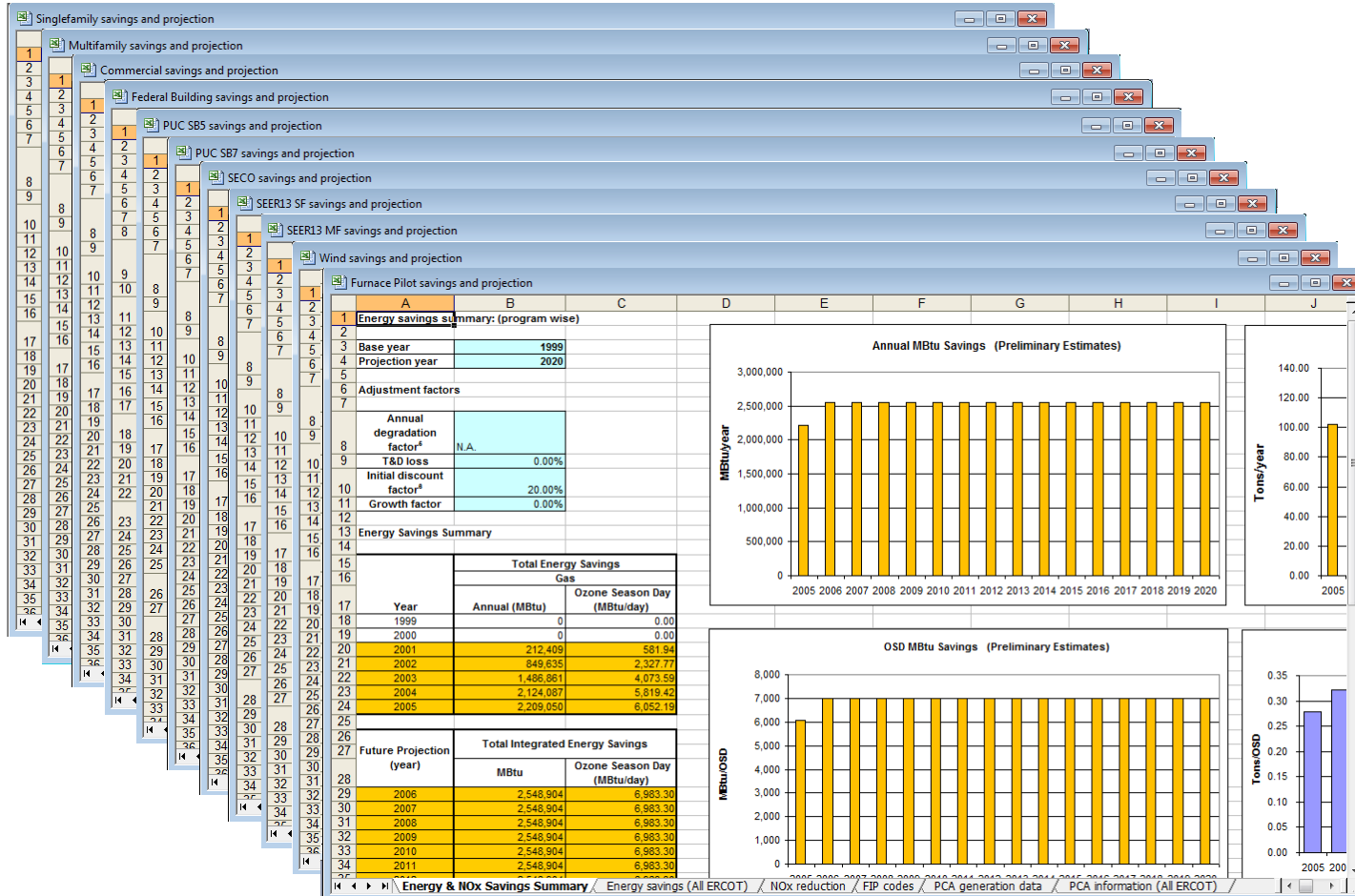


Wind



# INTEGRATED NOx SAVINGS:

## Final Summary Tables For Integrated NOx Reductions & Projections



Furnace Pilot



## INTEGRATED NOx SAVINGS:

### Final Summary Tables For Integrated NOx Reductions & Projections

The screenshot displays a complex spreadsheet titled "Energy & Nox Savings Summary". The top section lists various savings programs, each with a corresponding icon and a "Chart Individual" button. The programs include:

- Singlefamily savings and projection
- Multifamily savings and projection
- Commercial savings and projection
- Federal Building savings and projection
- PUC SB5 savings and projection
- PUC SB7 savings and projection
- SECO savings and projection
- SEER13 SF savings and projection
- SEER13 MF savings and projection
- Wind savings and projection
- Furnace Pilot savings and projection
- Integrated Savings Summary

The main data table is titled "Energy Savings Summary" and includes columns for various programs and their associated savings. The programs listed are:

- ESL-Single Family<sup>16</sup>
- ESL<sup>16</sup>-Multifamily
- ESL<sup>16</sup>-Commercial
- Federal Buildings<sup>15</sup>
- Furnace Pilot Light Program<sup>15</sup>
- PUC (SB7)<sup>15</sup>
- PUC (SB5 Grant Program)<sup>15</sup>
- SECO<sup>15</sup>
- Win ERCO<sup>15</sup>

The table also includes rows for "Annual Degradation", "T&D Loss", "Initial Discount Factor", "Growth Factor", and "Weather Normalized". The "Weather Normalized" row shows "Yes" for ESL-Single Family, ESL<sup>16</sup>-Multifamily, and ESL<sup>16</sup>-Commercial, and "No" for the other programs.

The bottom section of the spreadsheet provides a detailed breakdown of energy and electricity savings for the year 2002. It includes columns for "Program", "Electricity", "Ozone Season Day", and "Annual (MWh)". The programs listed are:

- ESL-Single Family
- ESL-Multifamily
- ESL-Commercial
- Federal Buildings
- Furnace Pilot Light Program (MBtu)
- PUC (SB7)
- PUC (SB5 grant program)
- SECO

The "Annual (MWh)" column shows values for each program, with the total annual savings for 2002 being 177,377 MWh. The "Ozone Season Day" column shows values for each program, with the total ozone season savings for 2002 being 486 MWh.

## Integrated Savings Summary

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Adjustment Factors

	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor											
T&D Loss											
Initial Discount Factor											
Growth Factor											
Weather Normalized											

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Adjustment Factors

	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor	5.00%	5.00%	5.00%	5.00%	N.A.	5.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss											
Initial Discount Factor											
Growth Factor											
Weather Normalized											

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Adjustment Factors

	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor	5.00%	5.00%	5.00%	5.00%	N.A.	5.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor											
Growth Factor											
Weather Normalized											

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Adjustment Factors

	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor	5.00%	5.00%	5.00%	5.00%	N.A.	5.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	0.00%	20.00%	20.00%
Growth Factor											
Weather Normalized											





# INTEGRATED NO<sub>x</sub> SAVINGS:

## Adjustment Factors

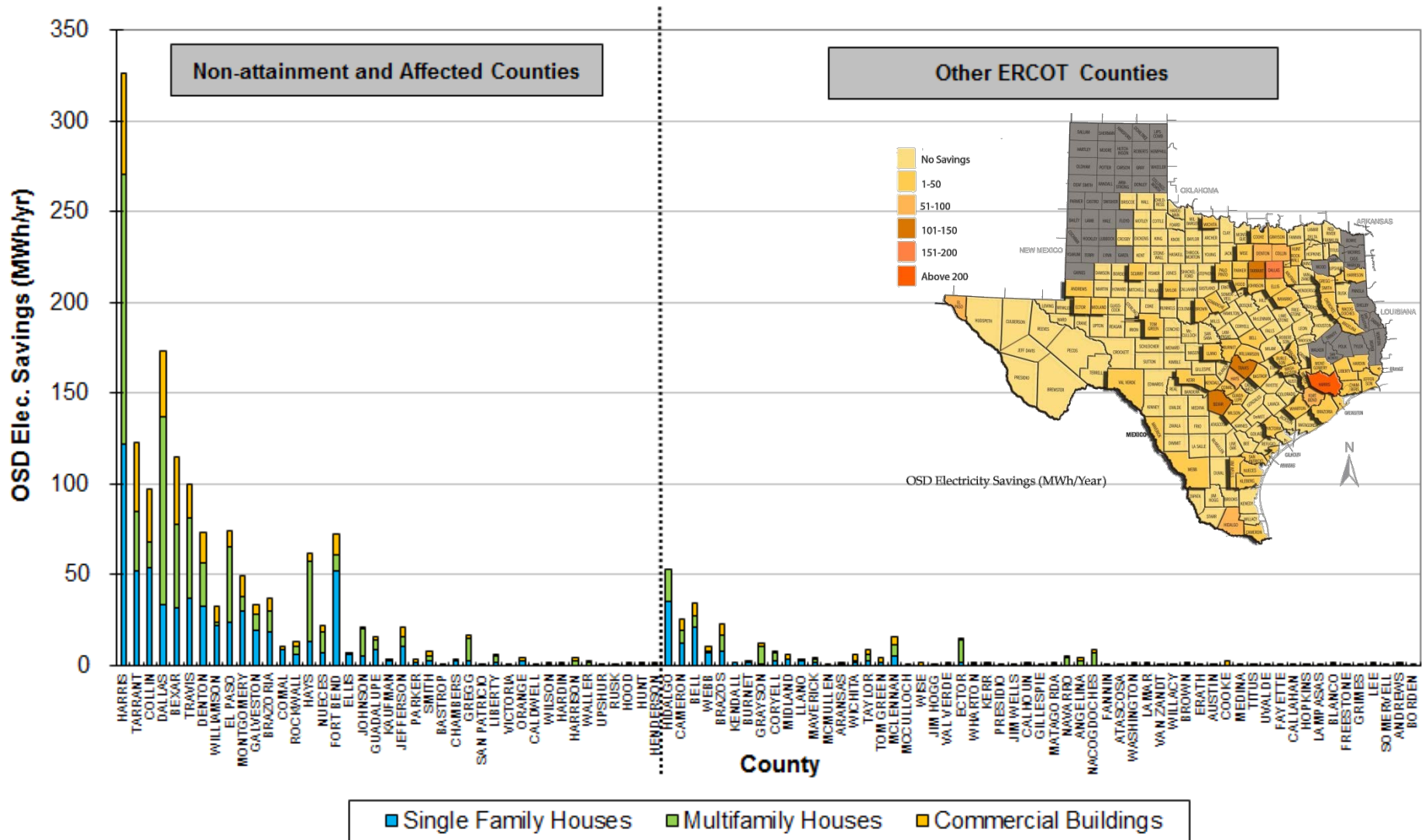
	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor	5.00%	5.00%	5.00%	5.00%	N.A.	5.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	0.00%	20.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	N.A.	0.00%	0.00%	N.A.	0.00%	Actual Rates	N.A.	N.A.
Weather Normalized											

# INTEGRATED NO<sub>x</sub> SAVINGS:

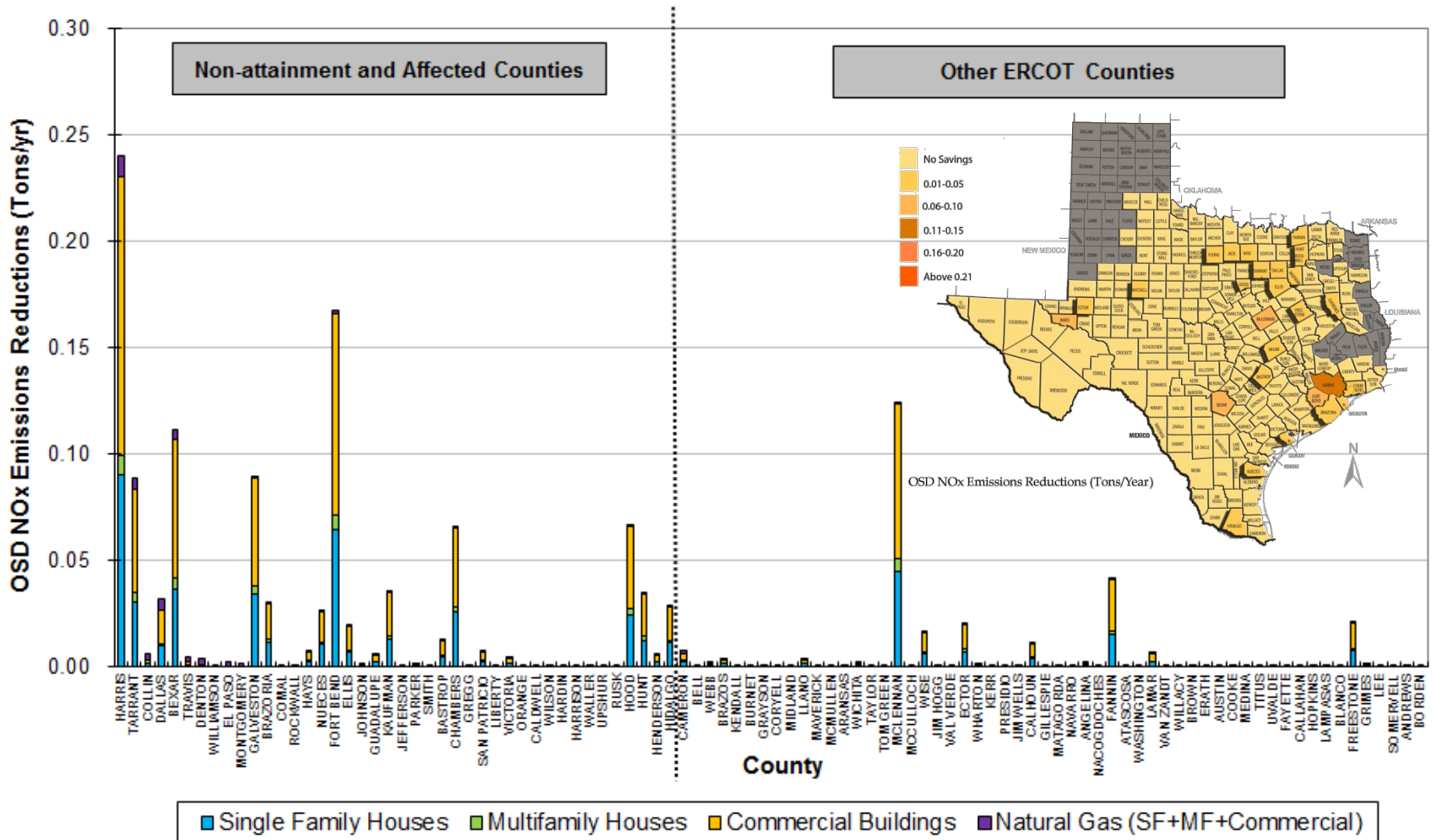
## Adjustment Factors

	ESL-Single Family	ESL- Multifamily	ESL- Commercial	Federal Buildings	Furnace Pilot Light Program	PUC (SB7)	PUC (SB5 Grant Program)	SECO	Wind- ERCOT	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor	5.00%	5.00%	5.00%	5.00%	N.A.	5.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	0.00%	20.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	N.A.	0.00%	0.00%	N.A.	0.00%	Actual Rates	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	No	No	See note 7	Yes	Yes

# INTEGRATED NO<sub>x</sub> SAVINGS: Result of OSD Electricity Savings

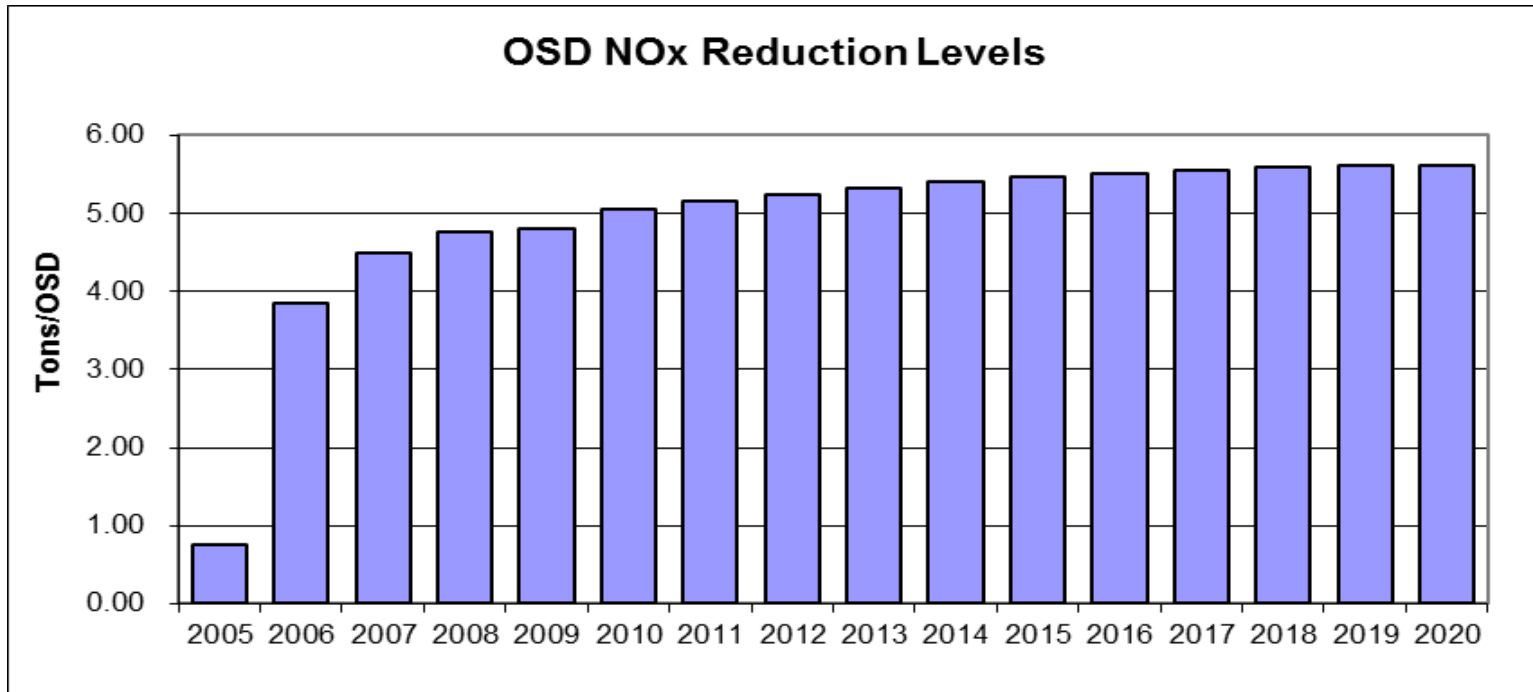


# INTEGRATED NO<sub>x</sub> SAVINGS: Result of OSD NO<sub>x</sub> Emissions Reductions



# INTEGRATED NOx SAVINGS:

## Single Family Savings and Projection

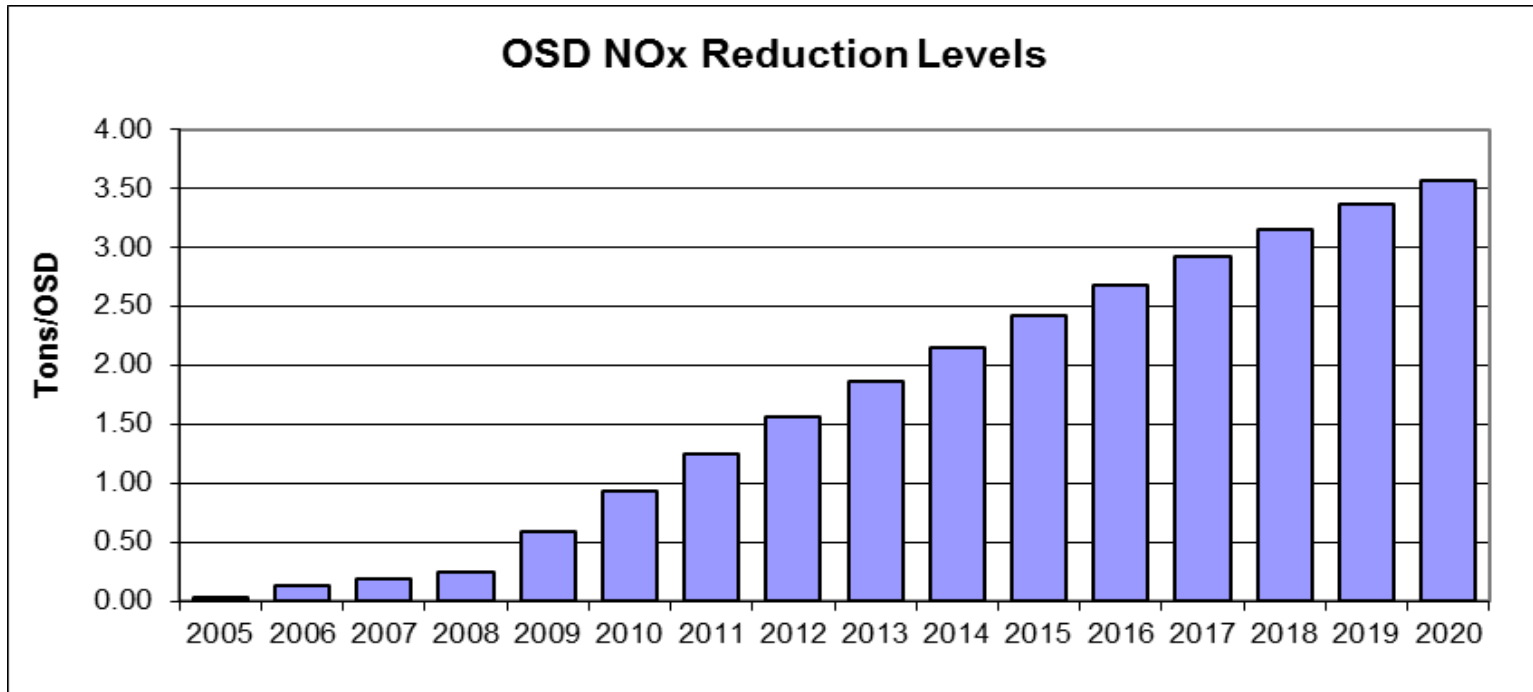


### CUMULATIVE NOx EMISSIONS SAVINGS (2013)

– ESL Code Compliance	(9.03 tons/day)	(26.3%)
– Federal Buildings	(0.81 tons/day)	( 1.9%)
– Furnace Pilot Lights	(0.32 tons/day)	( 0.8%)
– PUCs SB7,SB5 programs	(5.78 tons/day)	(11.7%)
– SECO Political Sub.	(1.01 tons/day)	( 2.0%)
– Green Power (Wind)	(32.63 tons/day)	(30.1%)
– <u>SEER 13 Retrofits</u>	<u>(11.03 tons/day)</u>	<u>(26.9%)</u>
<b>Total</b>	<b>(60.61 tons/day)</b>	<b>(100.0%)</b>

# INTEGRATED NOx SAVINGS:

## Multi-Family Savings and Projection

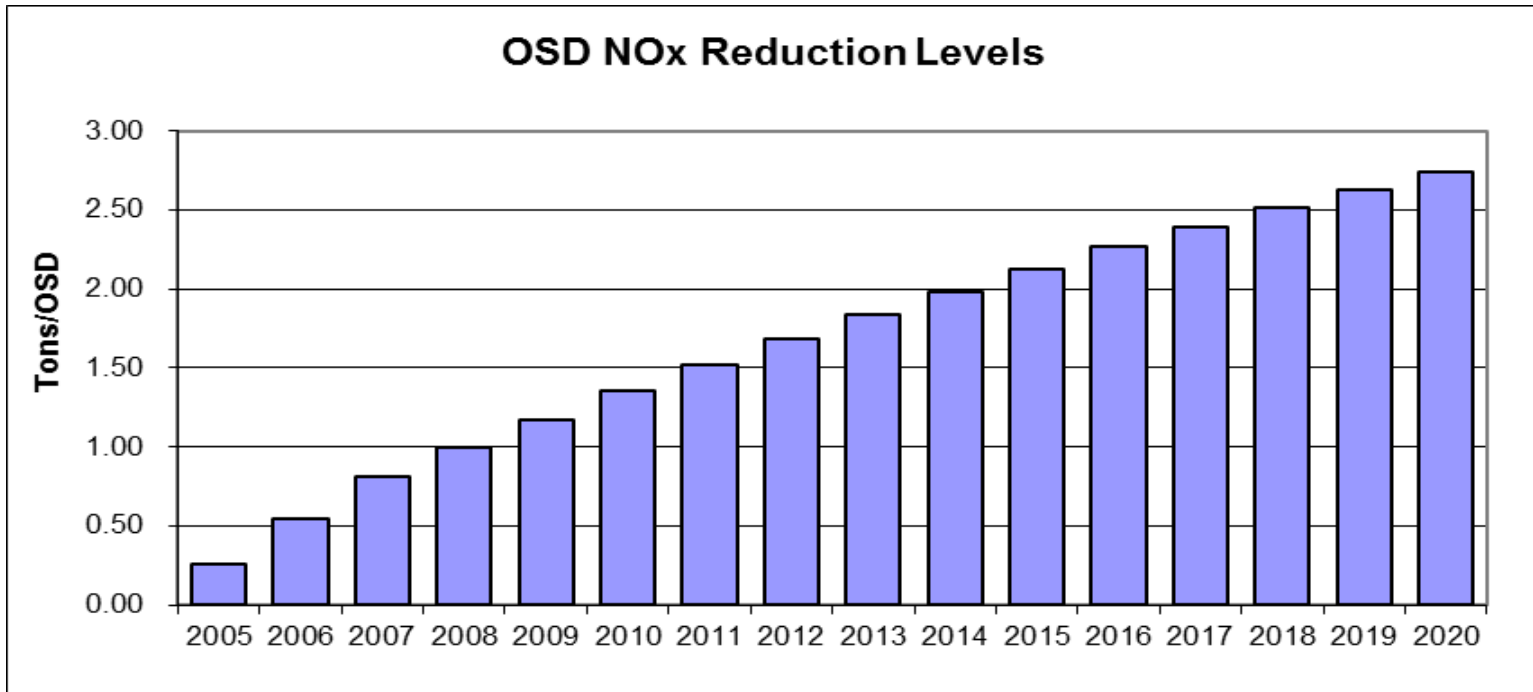


### CUMULATIVE NOx EMISSIONS SAVINGS (2013)

– ESL Code Compliance	(9.03 tons/day)	(26.3%)
– Federal Buildings	(0.81 tons/day)	( 1.9%)
– Furnace Pilot Lights	(0.32 tons/day)	( 0.8%)
– PUCs SB7,SB5 programs	(5.78 tons/day)	(11.7%)
– SECO Political Sub.	(1.01 tons/day)	( 2.0%)
– Green Power (Wind)	(32.63 tons/day)	(30.1%)
– SEER 13 Retrofits	(11.03 tons/day)	(26.9%)
<b>Total</b>	<b>(60.61 tons/day)</b>	<b>(100.0%)</b>

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Commercial Savings and Projection

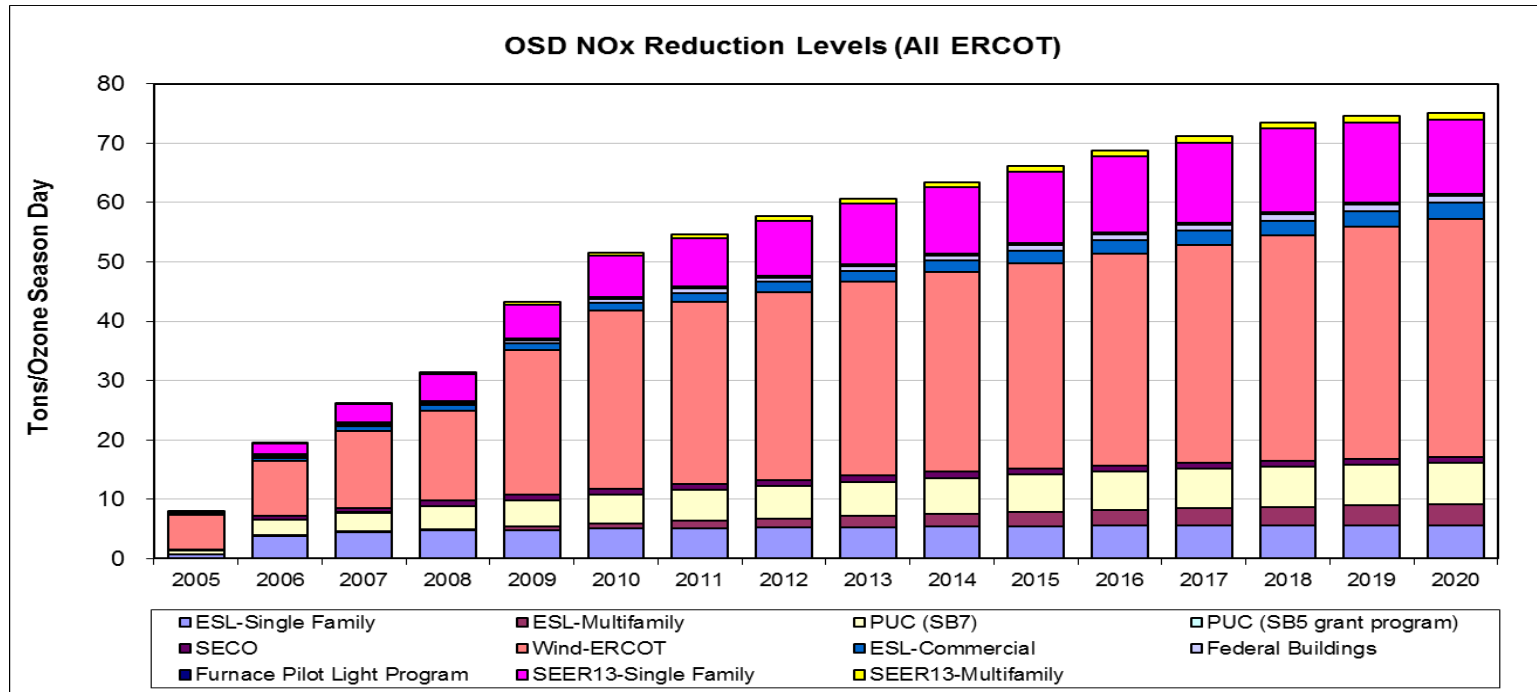


### CUMULATIVE NO<sub>x</sub> EMISSIONS SAVINGS (2013)

– ESL Code Compliance	(9.03 tons/day)	(26.3%)
– Federal Buildings	(0.81 tons/day)	( 1.9%)
– Furnace Pilot Lights	(0.32 tons/day)	( 0.8%)
– PUCs SB7,SB5 programs	(5.78 tons/day)	(11.7%)
– SECO Political Sub.	(1.01 tons/day)	( 2.0%)
– Green Power (Wind)	(32.63 tons/day)	(30.1%)
– <u>SEER 13 Retrofits</u>	<u>(11.03 tons/day)</u>	<u>(26.9%)</u>
<b>Total</b>	<b>(60.61 tons/day)</b>	<b>(100.0%)</b>

# INTEGRATED NO<sub>x</sub> SAVINGS:

## OSD NO<sub>x</sub> Emissions Reduction Projection through 2020



### CUMULATIVE NO<sub>x</sub> EMISSIONS SAVINGS (2013)

– ESL Code Compliance	(9.03 tons/day)	(26.3%)
– Federal Buildings	(0.81 tons/day)	( 1.9%)
– Furnace Pilot Lights	(0.32 tons/day)	( 0.8%)
– PUCs SB7, SB5 programs	(5.78 tons/day)	(11.7%)
– SECO Political Sub.	(1.01 tons/day)	( 2.0%)
– Green Power (Wind)	(32.63 tons/day)	(30.1%)
– SEER 13 Retrofits	(11.03 tons/day)	(26.9%)
<b>Total</b>	<b>(60.61 tons/day)</b>	<b>(100.0%)</b>



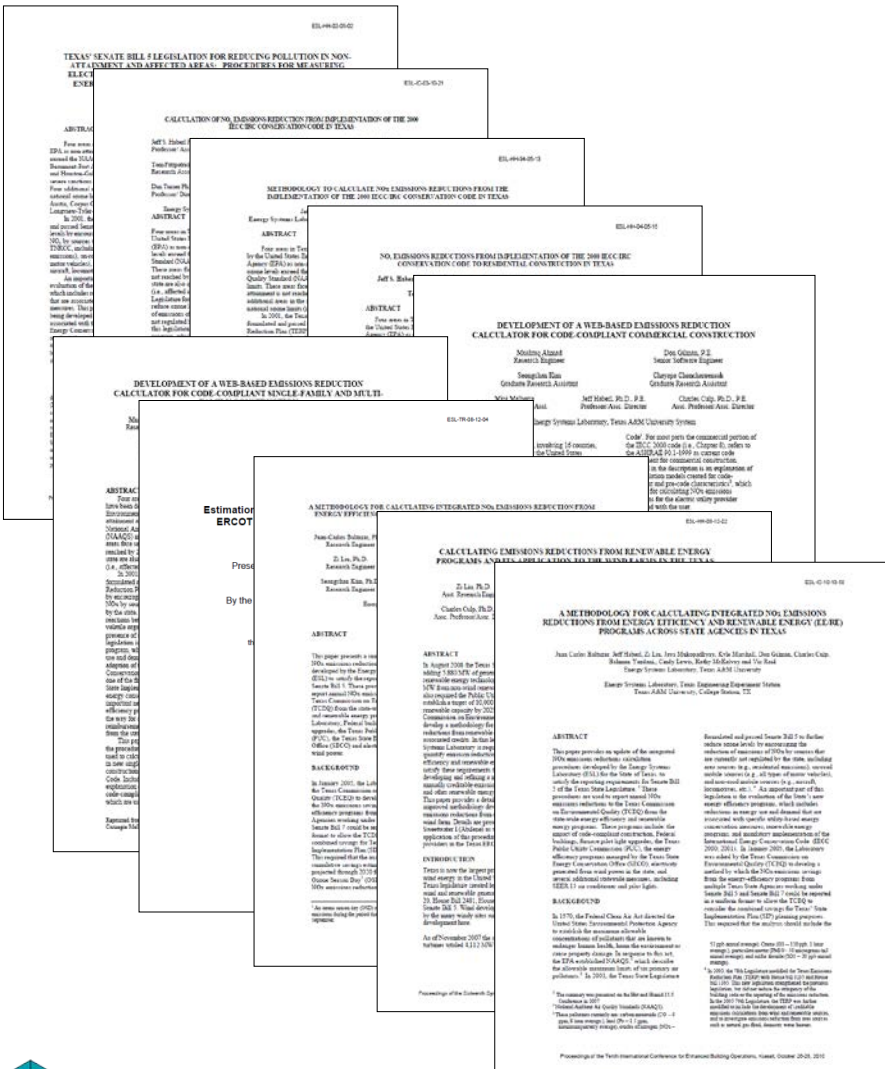
# **INTEGRATED NO<sub>x</sub> SAVINGS:**

## **Publications (2002~2012)**



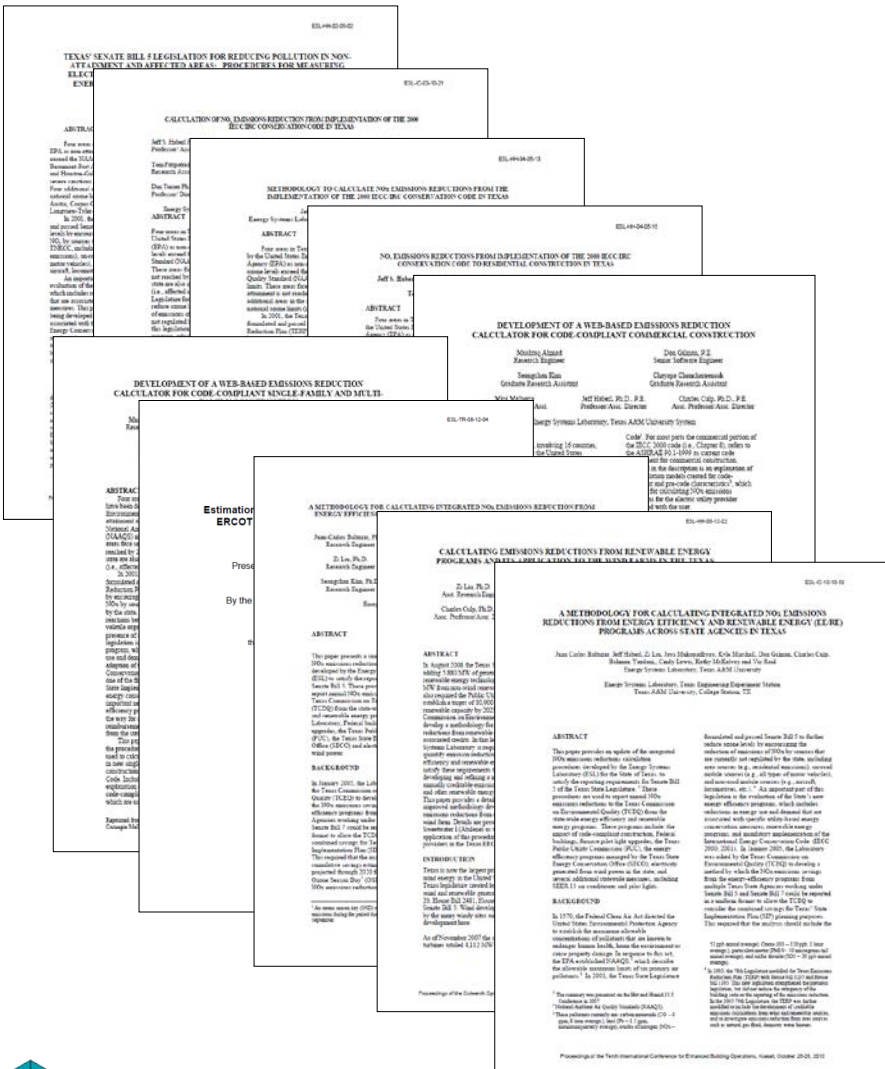
# INTEGRATED NOx SAVINGS: Publications (2002~2012)

## Papers

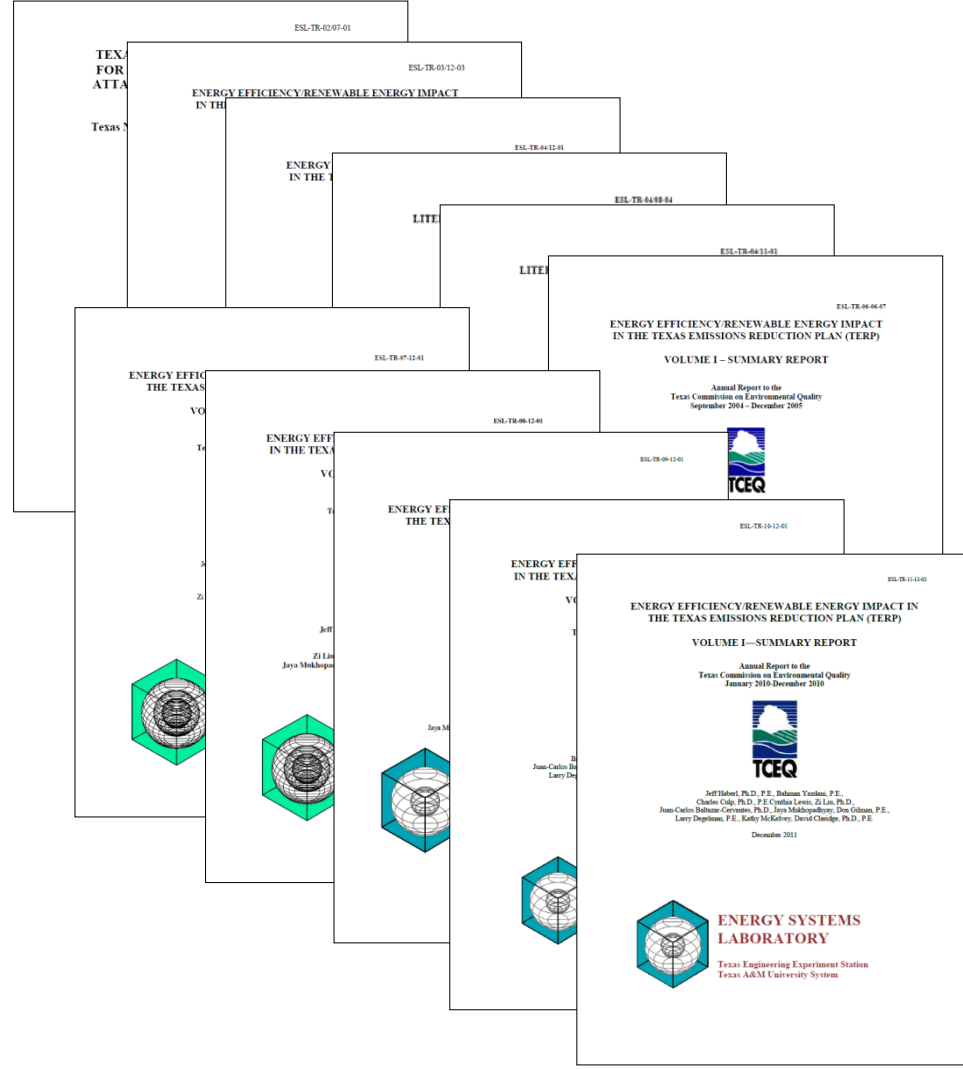


## INTEGRATED NO<sub>x</sub> SAVINGS: Publications (2002~2012)

## Papers

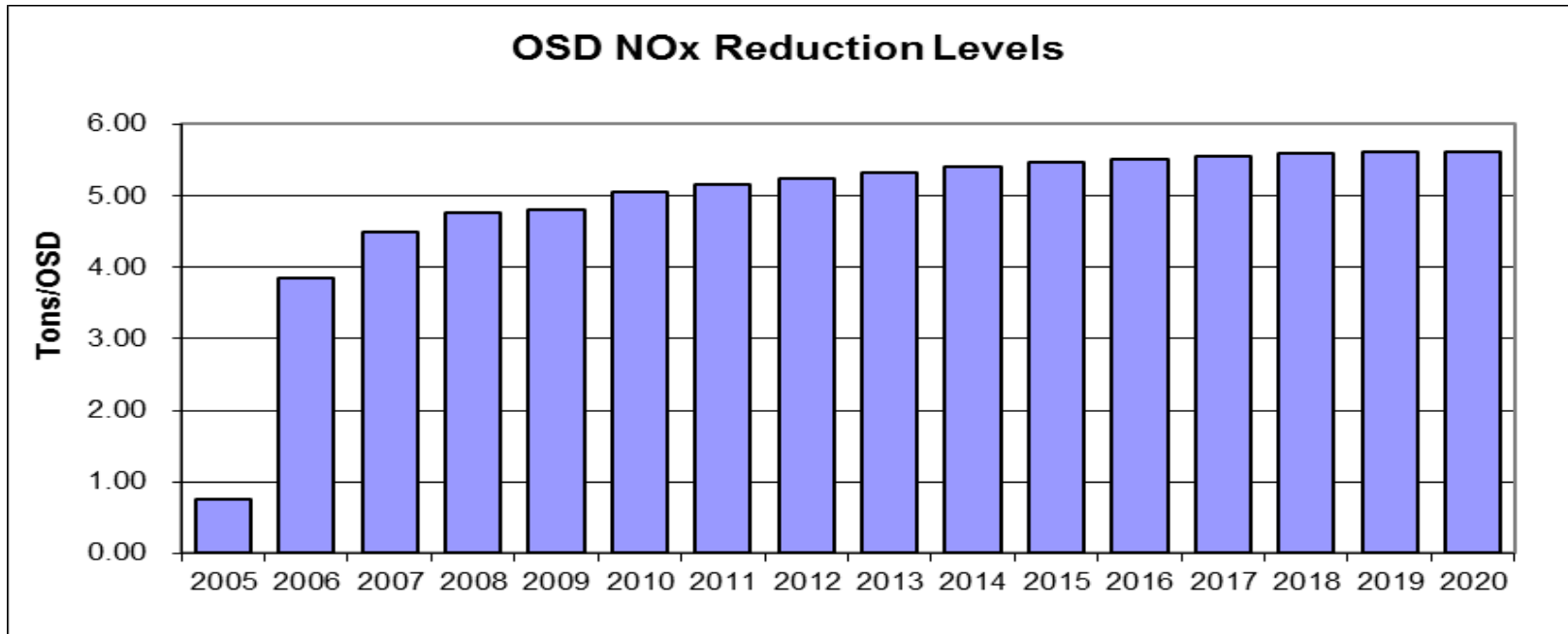


## Annual Reports to the TCEQ



# INTEGRATED NO<sub>x</sub> SAVINGS:

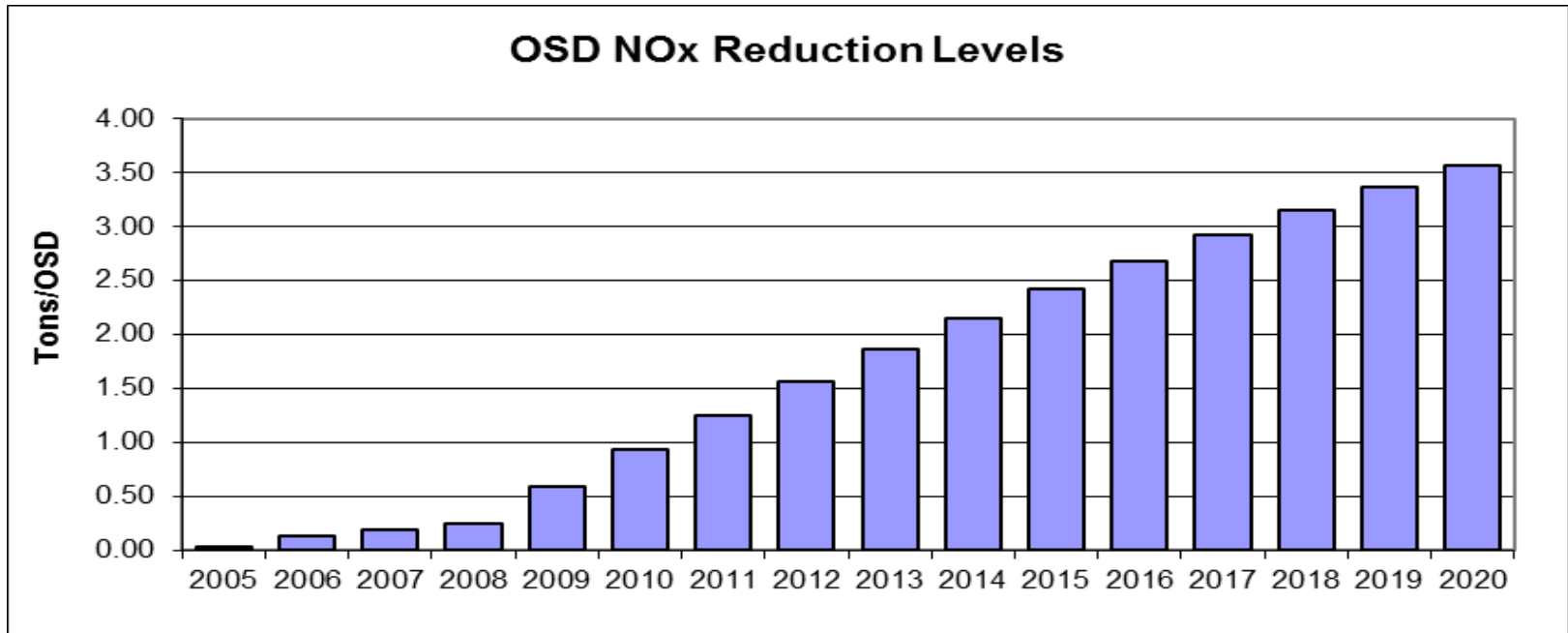
## Single Family Savings and Projection



- Single- and multi-family programs include the energy savings attained by constructing new residences in Texas according to the IECC 2000/2001 building code (IECC 2000).
- Electricity Savings due to the code adoption for new SF & MF residences were estimated using DOE-2.1 simulation program. Pre-code houses : average new house built in 1999 in Texas.
- It was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2010 through 2020. This would include the appropriate discount and degradation factors for each year

# INTEGRATED NO<sub>x</sub> SAVINGS:

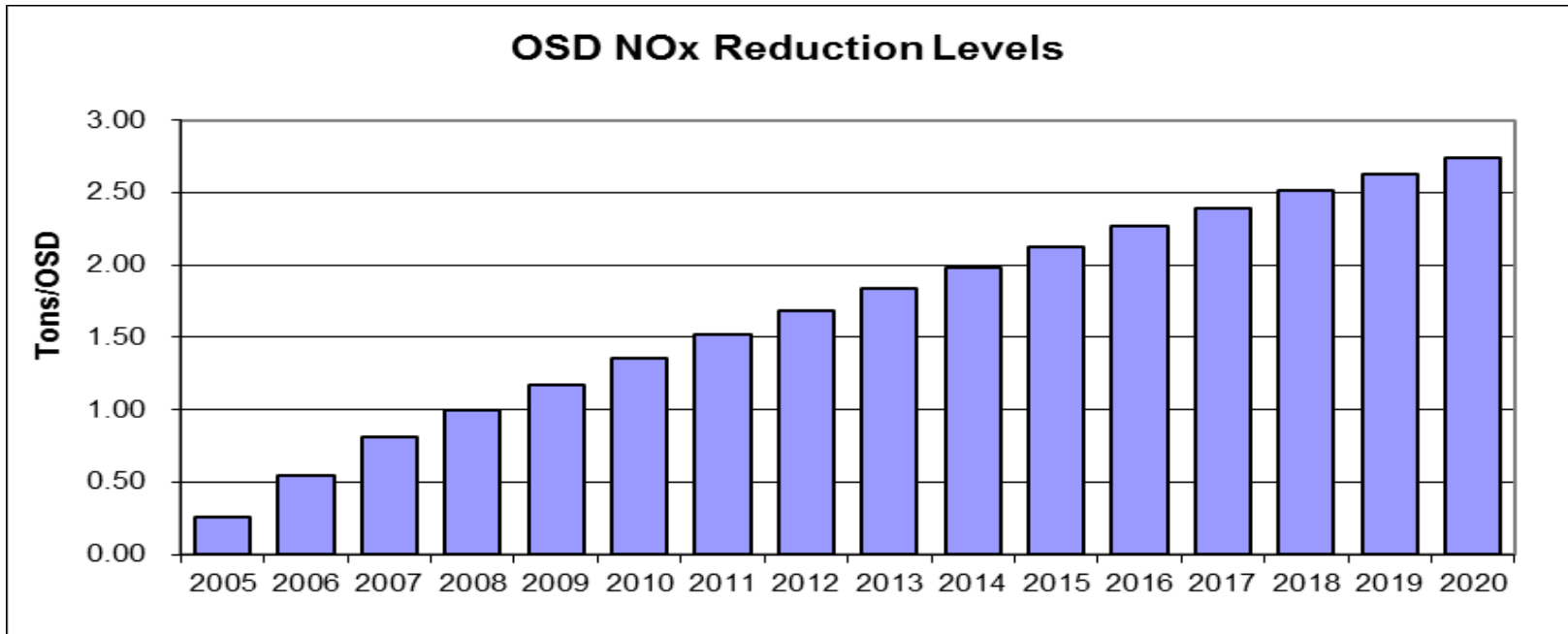
## Multi-Family Savings and Projection



- Single- and multi-family programs include the energy savings attained by constructing new residences in Texas according to the IECC 2000/2001 building code (IECC 2000).
- Electricity Savings due to the code adoption for new SF & MF residences were estimated using DOE-2.1 simulation program. Pre-code houses : average new house built in 1999 in Texas.
- It was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2010 through 2020. This would include the appropriate discount and degradation factors for each year

# INTEGRATED NO<sub>x</sub> SAVINGS:

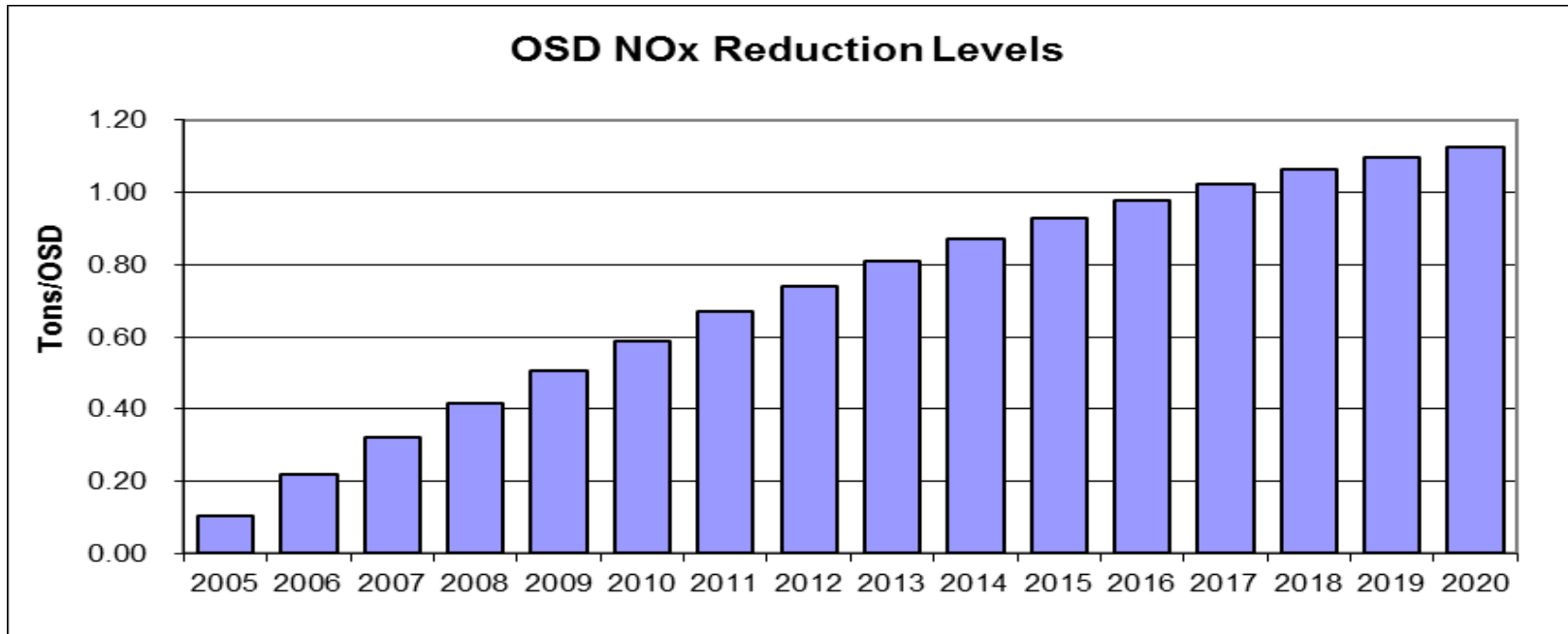
## Commercial Savings and Projection



- These savings include new construction in office, assembly, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 1995, 1999, 2003), using energy savings from the Pacific Northwest National Laboratory (USDOE 2005), and data from CBECS (2005).
- Electricity Savings due to the code adoption for new commercial buildings were estimated using DOE-2.1 simulation program.
- Pre-code buildings: the ASHRAE standard 90.1-1989 compliant building.
- Code compliant buildings: the ASHRAE standard 90.1-1999 compliant building.

# INTEGRATED NO<sub>x</sub> SAVINGS:

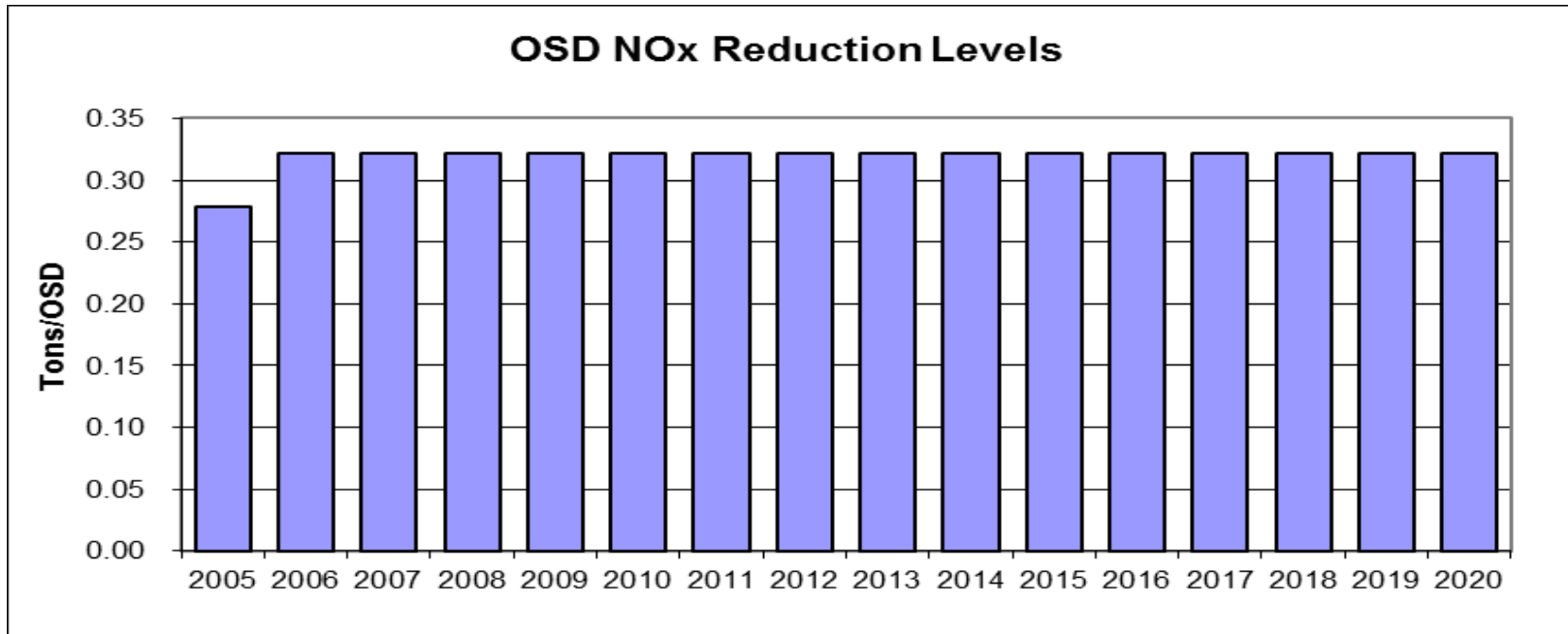
## Federal Savings and Projection



- The 2006 savings include projects implemented in 14 Federal buildings reported by the regional office of the Department of Energy.
- It was assumed that the electricity savings from 2005 would also be achieved for each year from 2006 through 2020 after the appropriate degradation factors were applied

# INTEGRATED NO<sub>x</sub> SAVINGS:

## Furnace Pilot Savings and Projection

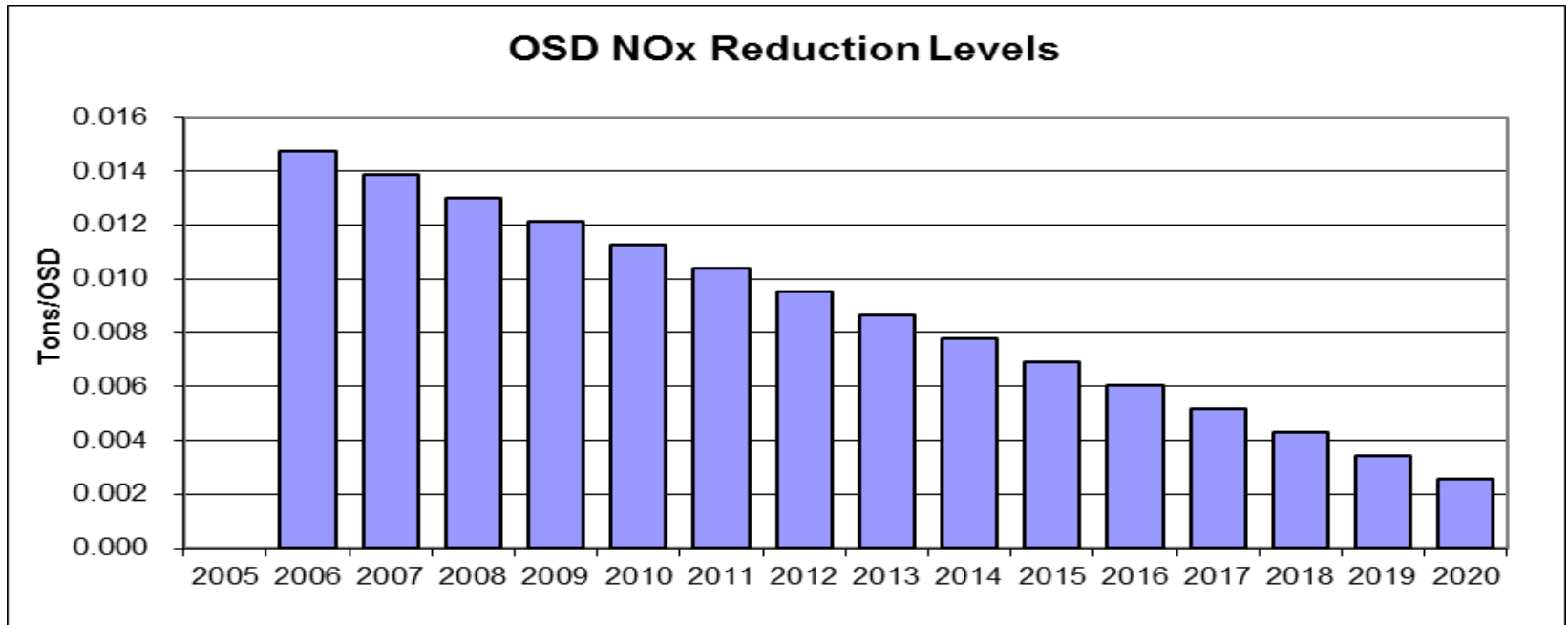


- N.G. energy savings achieved by retrofitting existing furnaces in single-family and multi-family residences for the entire residential stock for Texas have been projected until 2020.
- Pilot light removal saves at least 500 Btu/hr of natural gas (Emission rate per pilot light: 0.092 lb-NO<sub>x</sub>/MMBtu) for each hour of operation for the entire life of the furnace when the furnace is replaced with a code-compliant replacement.
- It is also being assumed that of the total furnaces that were retrofitted, 75% are operational during the Ozone Season Period.



# INTEGRATED NO<sub>x</sub> SAVINGS:

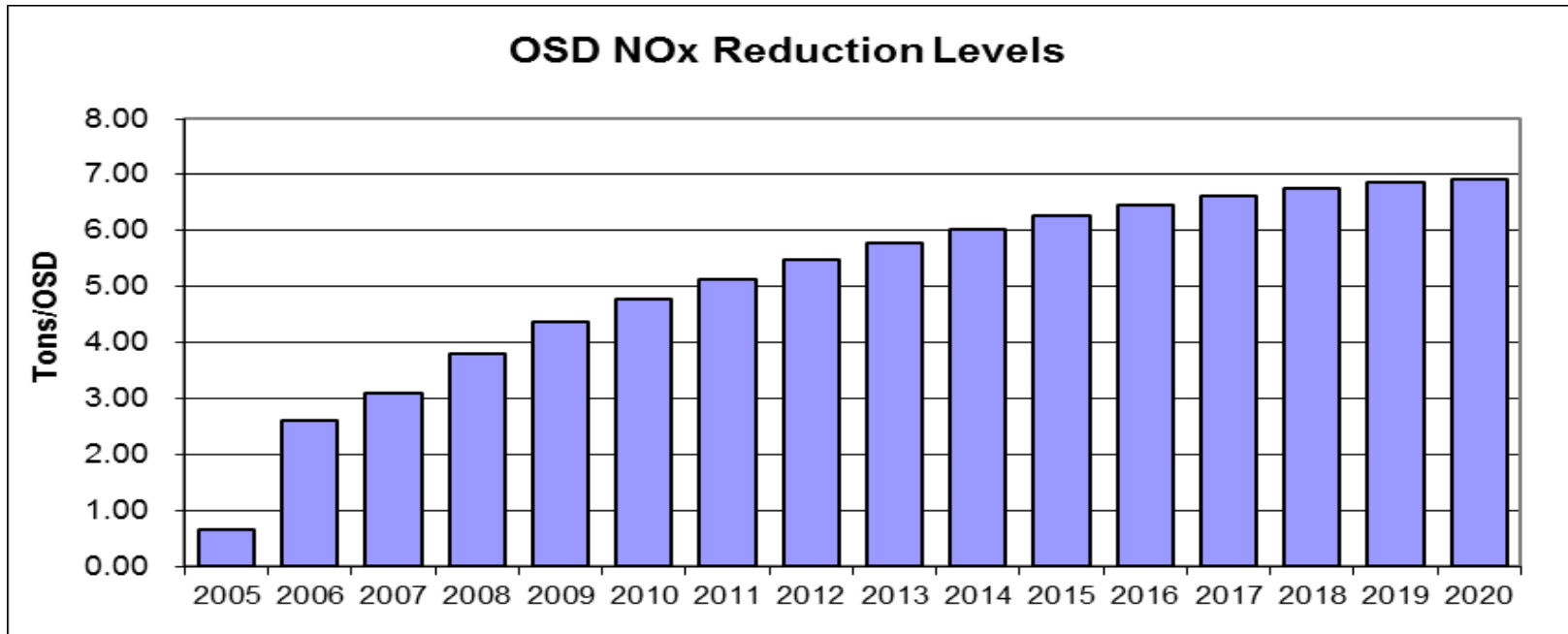
## PUC SB5 Savings and Projection



- The Texas Public Utility Commission's (PUC) Senate Bill 5 and Senate Bill 7 programs include their incentive and rebates programs managed by the different Utilities for Texas (PUC 2007).
- These include the Residential Energy Efficiency Programs (REEP) as well as the Commercial & Industrial Standard Offer Programs (C&I SOP).

# INTEGRATED NO<sub>x</sub> SAVINGS:

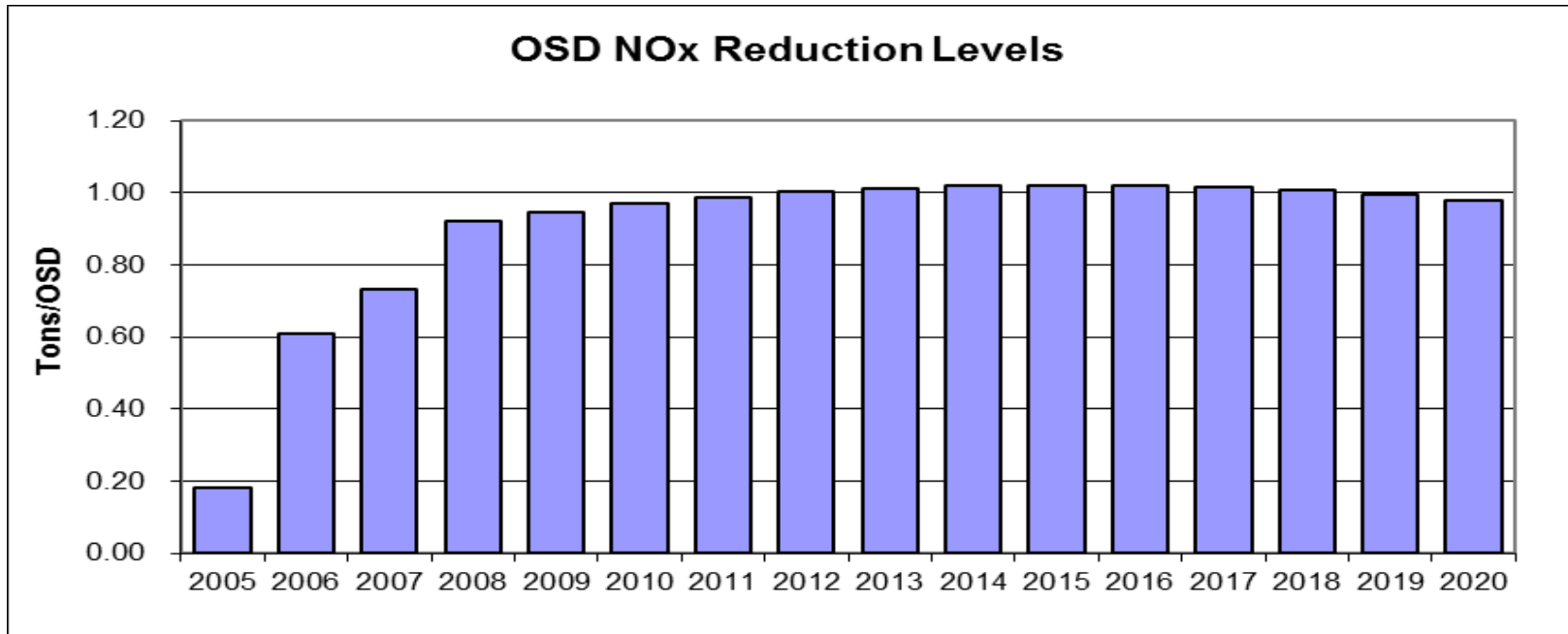
## PUC SB7 Savings and Projection



- The Texas Public Utility Commission's (PUC) Senate Bill 5 and Senate Bill 7 programs include their incentive and rebates programs managed by the different Utilities for Texas (PUC 2007).
- These include the Residential Energy Efficiency Programs (REEP) as well as the Commercial & Industrial Standard Offer Programs (C&I SOP).

# INTEGRATED NO<sub>x</sub> SAVINGS:

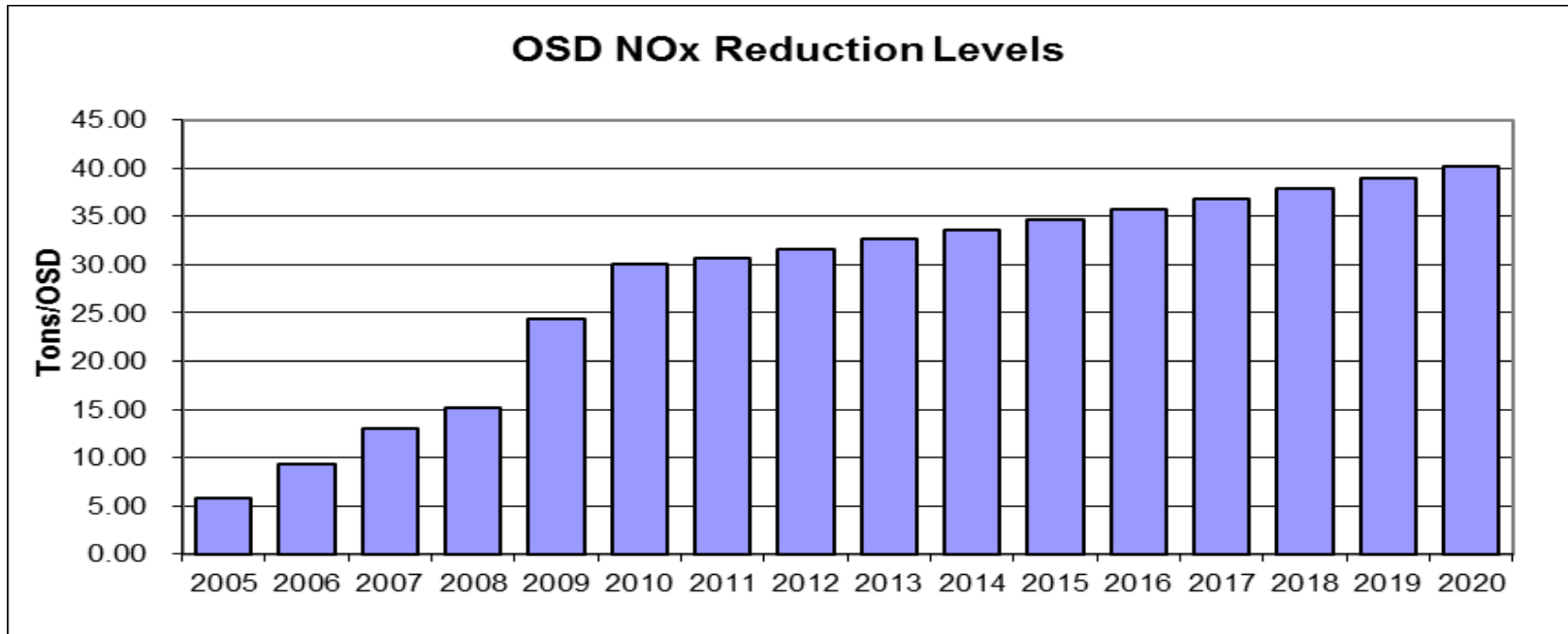
## SECO Savings and Projection



- The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers.
- The annual electricity savings from energy conservation projects reported by political subdivisions for 35 counties through 2006 were obtained from the State Energy Conservation Office. These submittals included information gathered from SECO's website and paper submittals.

# INTEGRATED NO<sub>x</sub> SAVINGS:

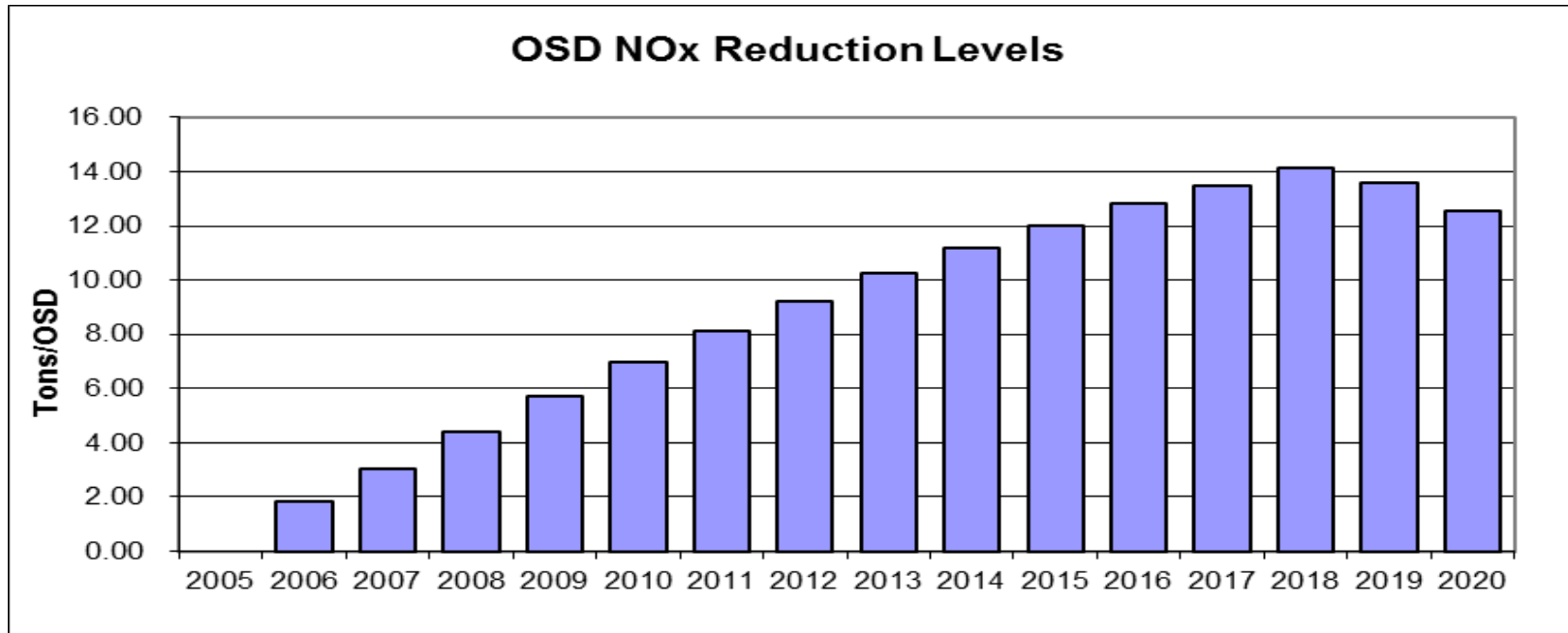
## Wind Savings and Projection



- For saving projections, annual growth factors were chosen to comply with the yearly goals set forth by the Senate Bill 20, Section 39.904, Utilities Code: 3,700 MW in 2009, and 7,000 MW in 2015.
- Actual measured electricity production for 2001 through 2006 were also included.

# INTEGRATED NO<sub>x</sub> SAVINGS:

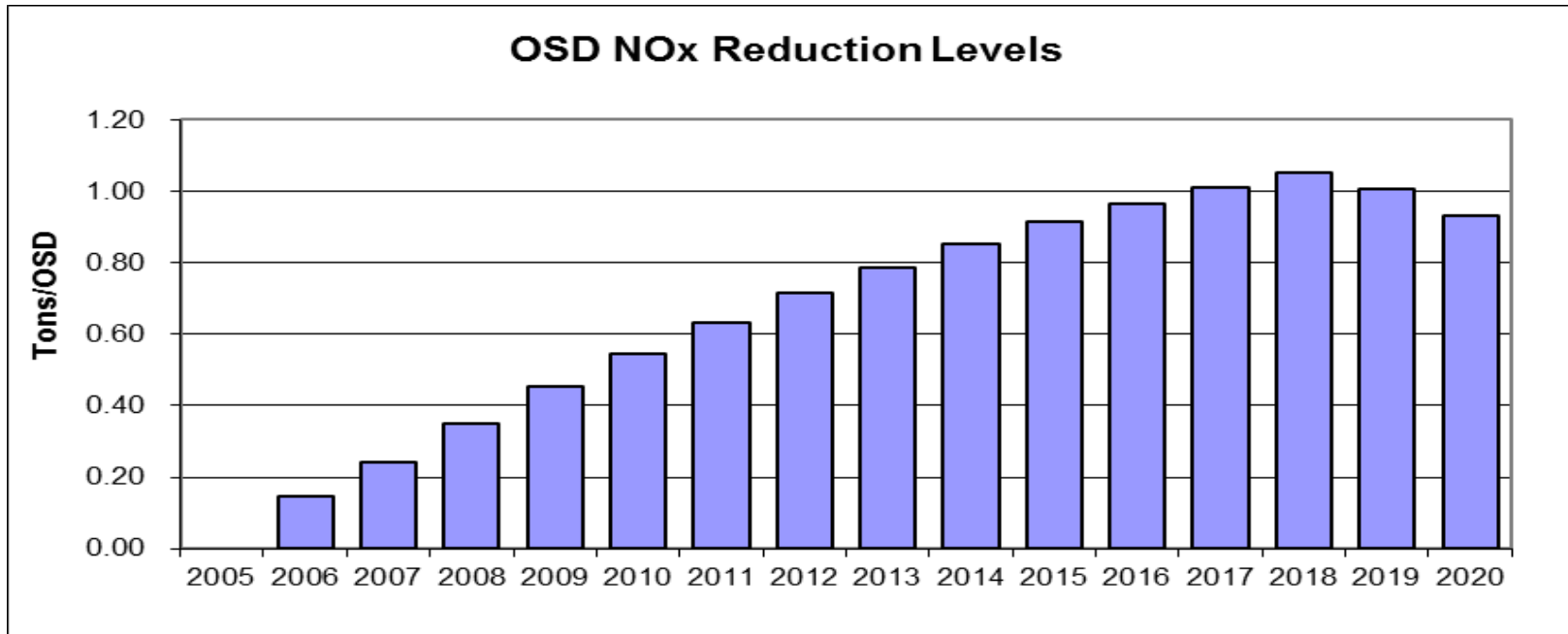
## SEER13 Single Family Savings and Projection



- The annual and OSD electricity savings due to replacement of SEER 13 air conditioning units for existing residences are estimated using DOE-2.1 simulation.
- In this analysis it was assumed that an equal number of existing houses had their air conditioners replaced as reported for 2006 by the air conditioner manufacturers using the ARI data (i.e., Texas Manufacturer's Shipments of 1 phase unitary products).
- This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners.

# INTEGRATED NO<sub>x</sub> SAVINGS:

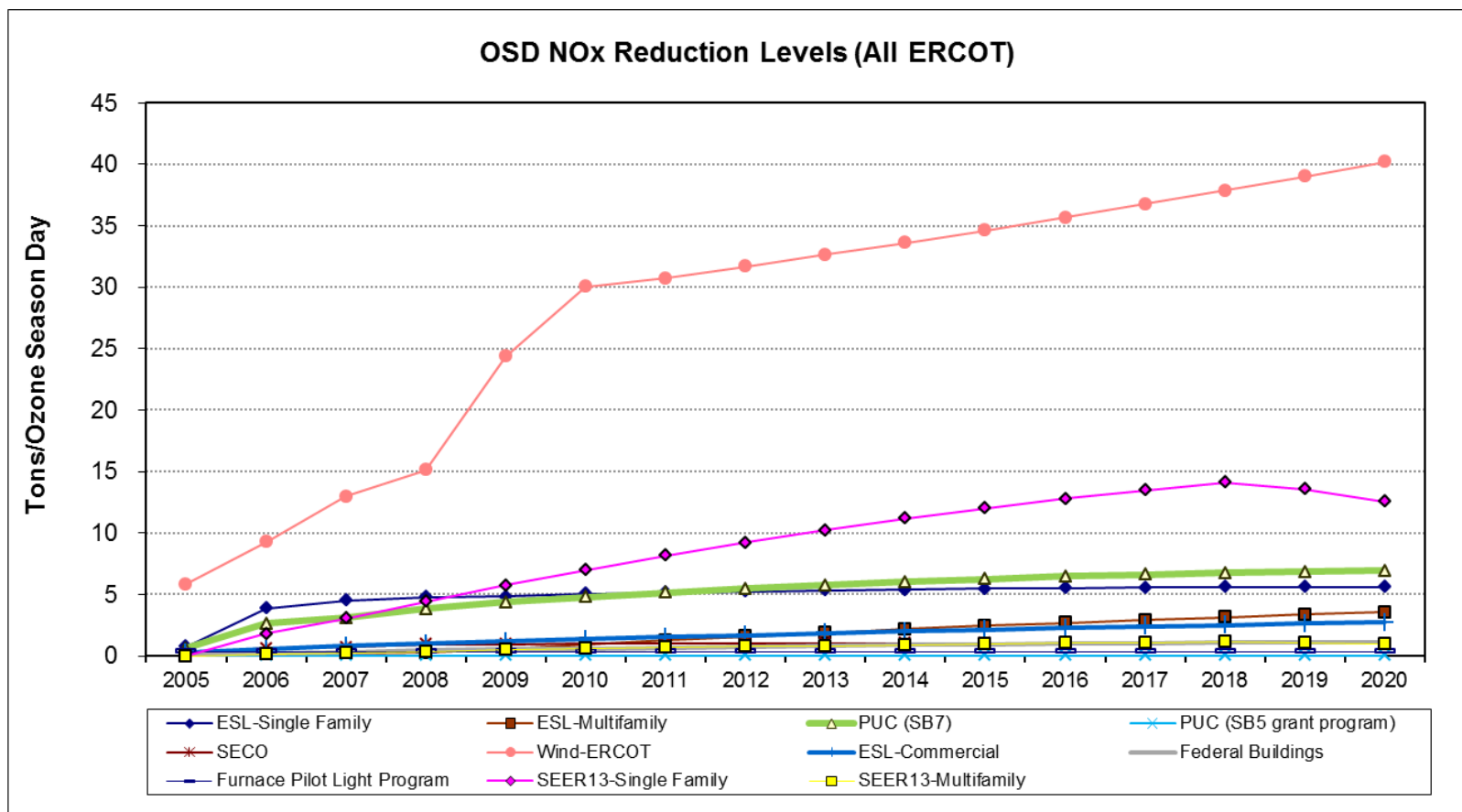
## SEER13 Multi-Family Savings and Projection



- The annual and OSD electricity savings due to replacement of SEER 13 air conditioning units for existing residences are estimated using DOE-2.1 simulation.
- In this analysis it was assumed that an equal number of existing houses had their air conditioners replaced as reported for 2006 by the air conditioner manufacturers using the ARI data (i.e., Texas Manufacturer's Shipments of 1 phase unitary products).
- This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners.

# INTEGRATED NO<sub>x</sub> SAVINGS:

## OSD NO<sub>x</sub> Emissions Reduction Projection through 2020



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